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Overview of progress towards sustainable development: a review of the implementation of Agenda 21, the Programme for the Further Implementation of Agenda 21 and the Johannesburg Plan of Implementation

Report of the Secretary-General

Summary

The present report has been prepared at a critical moment. In 2008, the global economy was affected by a succession of crises, the effects of which still threaten to reverse progress on all key dimensions of sustainable development. As a result, the progress being made on attaining the goals of Agenda 21, the Johannesburg Plan of Implementation and the Millennium Summit has been placed in jeopardy. After a steadily declining trend, poverty rates are beginning to inch up again, the incidence of hunger and malnutrition are increasing and the hope of achieving the Millennium Development Goals is being threatened. On the other hand, the succession of crises has led to an enhanced political commitment to achieving these goals. The focus herein is on important recent developments, new data and the progress made in understanding "what works".

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I. Introduction

1. The present report provides a brief review of the progress made in the implementation of Agenda 21,¹ the Programme for the Further Implementation of Agenda 21² and the Plan of Implementation of the World Summit on Sustainable Development ("Johannesburg Plan of Implementation").³ Not considered here or not elaborated extensively are topics covered in separate reports submitted to the Commission on Sustainable Development at its eighteenth session: that is, on transport, chemicals, waste management, mining and the 10-year Framework of Programmes for Sustainable Consumption and Production Patterns under the Marrakech Process. The focus herein is on important recent developments, new data and progress in understanding "what works".

II. Overview

2. Depending on how sustainable development, with its three pillars, is approached, global development can unfold along dramatically different pathways. It has been two decades since the concept of "sustainable development" entered the lexicon of the international community, inspiring countless international meetings and even some action. However, the first wave of sustainability activity, in progress since the Earth Summit⁴ of 1992, has been insufficient to reverse alarming global trends in resource depletion and environmental degradation. In a finite planet, the continued growth in the use of materials or throughput will eventually lead to ecological disaster. A shift to more resource-efficient and sustainable patterns of consumption and production is therefore required. However, continued economic growth is absolutely essential, at least until the large differences between developed and developing countries — in income, quality of life, human development indicators and levels of poverty and deprivation — are bridged. In the first instance, the concept proposes that the unfinished development agenda be completed apace, but in a manner that minimizes the pressure on natural resources and starts laying the foundation of the transition to a sustainable society.

3. Going beyond this level, however, the concept also seeks to show that the development agenda and the sustainability agenda are not in conflict. In fact, the more speedily the unfinished agenda of development and poverty eradication is completed, the more quickly can there be a transformation towards a sustainable society.

4. A new wave must produce a new sustainability paradigm which would challenge both the viability and desirability of conventional values, economic structures and social arrangements. It would offer a positive vision of a civilized

¹ *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

² General Assembly resolution S-19/2, annex.

³ *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex.

⁴ *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

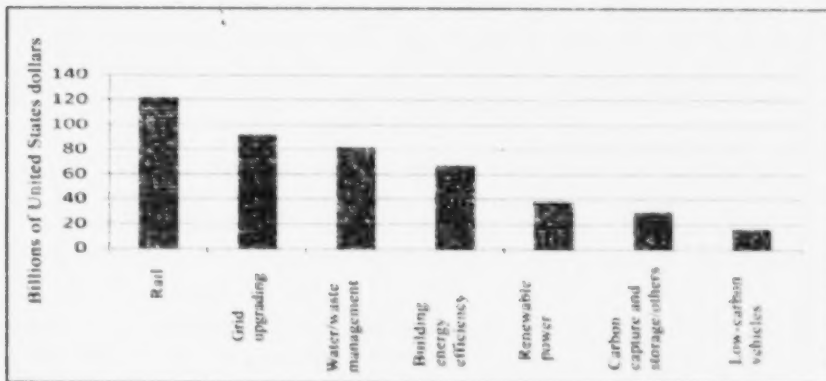
form of globalization for the entire human family. However, this will happen only if key sectors of global society come to understand the nature and the gravity of the challenge, and seize the opportunity to revise their agendas.⁵

5. These current economic and environmental difficulties offer an opportunity for global collective rethinking of the development and business models that had been used over the last century, and for a shift to a new model that would help to put the world on a climate-friendly and sustainable economic path. One innovative response is the "green economy", which would entail a transition towards an economic system dominated by the production, exchange, distribution and consumption of environmentally friendly goods and services.

6. Through a green-growth process, such a transition could offer a way forward out of the current crisis, as well as a means of promoting competitiveness in the industries of the future through the creation of so-called green jobs, the preservation of the Earth's natural capital, the alleviation of poverty and thus the enabling of green growth at the global level. A green economy is one that includes green investment as a central pillar of both government budgets and public-private funding mechanisms. Several countries are already prioritizing green investment and developing strategies and policies to support a green economy, while researchers are developing the conceptual and empirical support for such policies.

7. In the aftermath of the recent financial and economic crisis, many Governments around the world have announced massive fiscal stimulus packages of over \$3 trillion (see figures I and II).

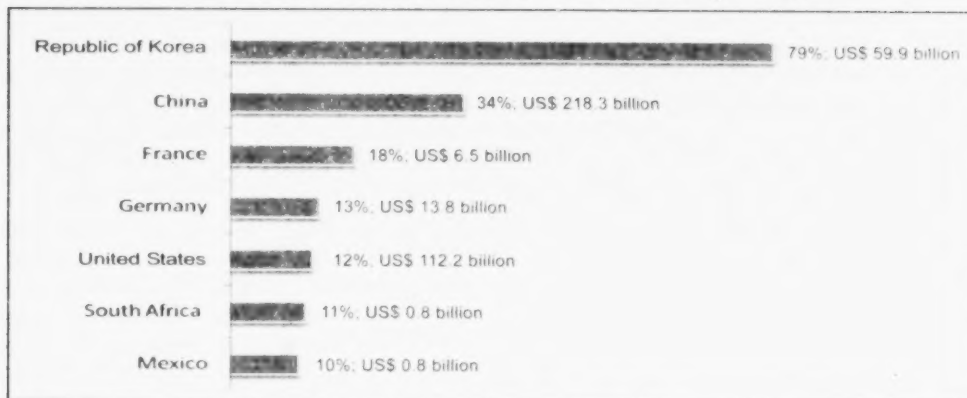
Figure I
Group of Twenty green stimulus spending per sector



Source: HSBC Global Research and the United Nations Environment Programme.

⁵ See Paul Raskin, Tariq Banuri, Gilberto Gallopin, Pablo Gutman, Al Hammond, Robert Kates and Rob Swart, *Great Transition: The Promise and Lure of the Times Ahead*, Stockholm Environment Institute, Boston, United States of America, 2002.

Figure II
Green stimulus ranking as a percentage of total stimulus, as of August 2009



Source: HSBC Global Research and the United Nations Environment Programme.

8. About 15 per cent of the announced total economic stimulus packages have been allocated to green fiscal and investment measures to support renewable energy, energy efficiency in buildings, grid upgrading, water and waste management and railway networks.

9. An investment of 1 per cent of global GDP over the next 2 years could provide the critical mass of green infrastructure needed to seed a significant greening of the global economy (of course, the specific focus of the investment would differ between developed and developing countries, as would the mix of fiscal and aid funding). The overall size of this recommended "green" stimulus is well within the realm of the possible: at 1 per cent of global GDP, that is, approximately \$750 billion, the amount is only one fourth of the total size of proposed fiscal stimulus packages.⁶

10. As a response to the financial and economic crisis, these commitments represent the first steps towards a "global green new deal", which has three broad objectives: to make a major contribution to reviving the global economy, saving and creating jobs and protecting vulnerable groups; to promote sustainable and inclusive growth and the achievement of the Millennium Development Goals, especially ending extreme poverty by 2015; and to reduce carbon dependency and ecosystem degradation. These are key risks along a path to a sustainable global economy.⁷

11. Beyond recovery, efforts are needed to initiate and sustain a long-term process of greening the global economy, by reconfiguring businesses and infrastructure to deliver better returns on natural, human and economic capital investments, while at the same time reducing greenhouse gas emissions, extracting and using fewer natural resources, creating less pollution and waste and reducing social disparities, while remaining within the carrying capacity of ecosystems. At the same time, significant structural changes are necessary in the international and domestic policy architecture. Together, this set of actions could provide the foundations for the emergence of a future green economy. In this regard, the UNEP-led Green Economy

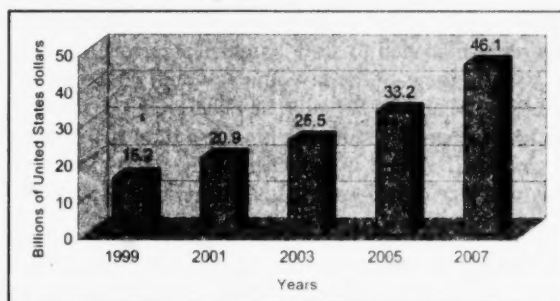
⁶ Edward B. Barbier, "A global green new deal", paper proposed for the UNEP Division of Technology, Industry and Economics, February 2009.

⁷ See *Global Green New Deal: Policy Brief*, UNEP, March 2009.

Initiative assists Governments in shaping and focusing policies, investments and spending towards a range of green sectors, such as clean technology, industry, renewable forms of energy, water services, transport, waste management, green buildings, and sustainable agriculture and forests. The initiative involves a number of UNEP and United Nations-wide initiatives that are aimed at providing convincing macroeconomic evidence for significantly increasing investments in the environment as a means of promoting sustainable economic growth, the creation of decent jobs and the reduction of poverty, while at the same time reducing greenhouse gas emissions, extracting and using less natural resources and creating less waste.

12. Forging a green economy is closely interlinked with efforts to promote sustainable consumption and production. Stimulating investments in sustainable production increases net welfare gains from economic activities by "doing more and better, with less". Sustainable production practices reduce resource use and depletion and result in less pollution. Likewise, spurring demand for more sustainable products through the promotion of sustainable consumption could create new markets for businesses adopting sustainable production practices, resulting in increased revenue streams and new jobs. For instance, major markets for organic food and beverages are expanding on average by 10-20 per cent per year and global trade in these products now stands at \$50 billion annually.

Figure III
Global market for organic food and drinks



Source: Research Institute of Organic Agriculture and International Federation of Organic Agriculture Movements. *The World of Organic Agriculture: Statistics and Emerging Trends 2010*, Bonn, Germany, FiBL and IFOAM, 2010.

III. Poverty eradication and human development

13. Human development is the process of enlarging people's choices. At all levels of development, the three essential choices are for people to lead a long and healthy life, to acquire knowledge and to have access to the resources needed for a decent standard of living. If these essential choices are not available, many other opportunities remain inaccessible. Development must be more than just the expansion of income and wealth. The focus of development must be people.⁸ Therefore, the subsequent paragraphs in this section should be taken in this context.

⁸ United Nations Development Programme, *Human Development Report 1990*, New York, UNDP and Oxford University Press, 1990.

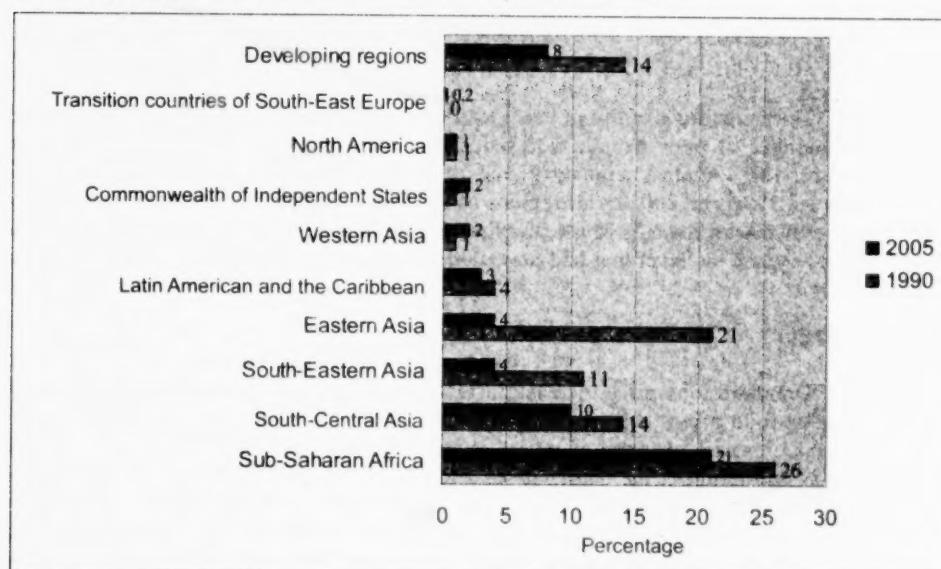
A. Poverty eradication

14. Poverty eradication has had mixed results. Prior to the recent global crisis and higher food prices, the number of people in developing regions of the world living in extreme poverty, that is, on less than US\$ 1.25 a day, fell from 1.8 billion in 1990 to 1.4 billion in 2005. As a result, those people considered as extremely poor accounted for slightly more than a quarter of the developing world's population in 2005, compared with almost half that population in 1990. There was a dramatic drop in the poverty rate in Eastern Asia, thanks in large part to rapid economic growth in China, which helped to lift 475 million people out of extreme poverty. Sub-Saharan Africa counted 100 million more extremely poor people in 2005 than in 1990, and the poverty rate remained above 50 per cent (although it had begun to decline after 1999).⁹

15. Deep inequalities across the world persist. The 40 per cent of the world's population living on less than US\$ 2 a day account for 5 per cent of global income, while rural areas account for three out of every four people living on less than \$1 a day. The richest 20 per cent account for three quarters of global income. In the case of sub-Saharan Africa, a whole region has been left behind: it will account for almost one third of global poverty in 2015, up from one fifth in 1990¹⁰ (see figures IV and V).

Figure IV

Poverty gap percentage ratio at US\$ 1.25 a day, 1990 and 2005

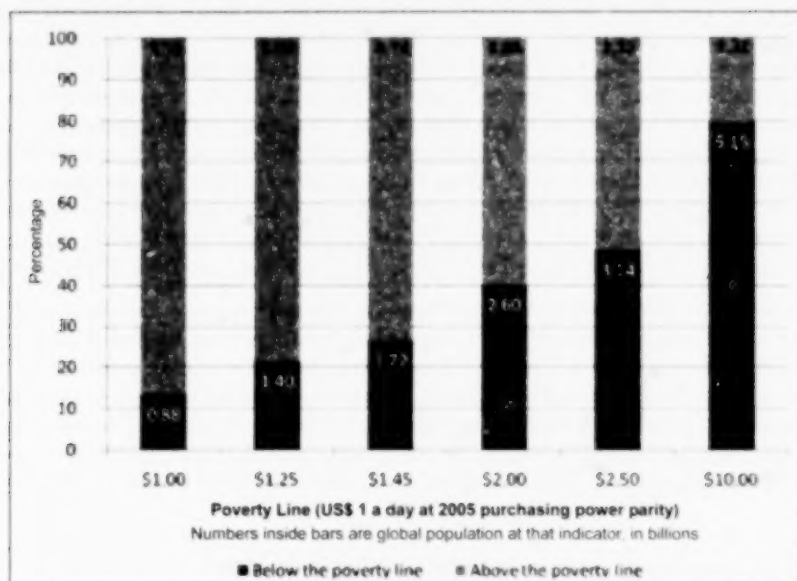


Source: Millennium Development Goals Report 2009.

⁹ United Nations, *The Millennium Development Goals Report 2009* (United Nations publication, Sales No. E.09.I.1).

¹⁰ United Nations Development Programme, *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World*, New York, UNDP, 2007.

Figure V
Percentage of people in the world at different poverty levels, 2005



Source: World Bank, *World Bank Development Indicators 2008*, Washington, D.C., World Bank, 2008.

16. The magnitude of the poverty eradication challenge is determined not only by the number of poor people worldwide, but also by how far they fall below the poverty line. Against a poverty line of \$1.25 a day, the poverty gap narrowed between 1990 and 2005 in all regions of the world except Western Asia. In 2005, the depth of poverty was greatest in sub-Saharan Africa, but has dropped lower since 1999 to reach the level that had prevailed in Eastern Asia in 1990.

B. Hunger

17. Dramatic food price increases affected much of the developing world in 2008. Even as food prices had begun to relax in 2009, this trend remains highly uneven across countries; in many countries local food prices are still high relative to past levels. Furthermore, the challenge of addressing the root causes of the global food crisis persists. Some factors behind the global food crisis that erupted in 2008 are immediate and possibly short-term in nature, such as the volatility in the commodities markets arising from short-term financial speculation. Others, however, are going to, or have already started to, affect countries' food security in the medium to longer term. These include (a) rising and changing patterns of consumption in fast-growing and large developing countries such as China and India; (b) the possibly increasing trade-off between biofuels and food; and (c) the unfolding effects of climate change.

18. In the short term, the vast majority of poor urban and rural households are being hit hardest by higher prices. Among the poor, it is the landless and female-

headed households that are most vulnerable to sharp rises in basic food prices.¹¹ Rapidly rising food prices caused the proportion of people going hungry in sub-Saharan Africa and Oceania to increase in 2008. When China is excluded, the prevalence of hunger also rose in Eastern Asia (see box 1).¹² In most of the other regions, the effect was to arrest the downward trend.⁹

Box 1

Philippines: price of rice increases poverty

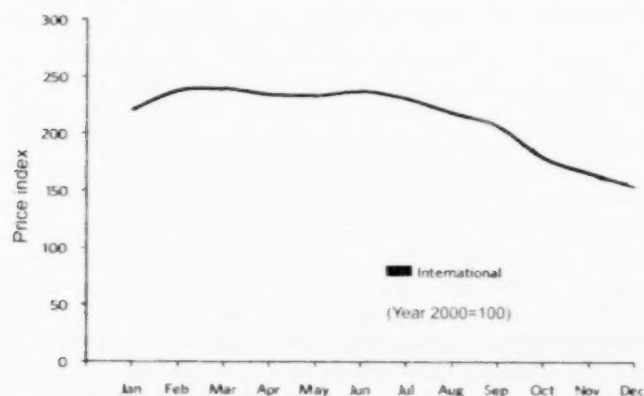
Soaring rice prices are pushing more families in the Philippines into poverty, making it more difficult for the country to achieve Millennium Development Goal 1 (halving the proportion of people living on less than US\$ 1 per day by 2015). More than 24 per cent of Philippine families were living in extreme poverty in 1991. While that rate had declined to 13.5 per cent in 2003, it has started rising again. Inflation rose by nearly 2 percentage points to 8.3 per cent from March to April 2008 and reached 9.6 per cent in May, the highest level since 1999.

Source: IRIN news service May/June 2008, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

19. Although prices have declined, the global economic recession is pushing households back into poverty and therefore sustaining food insecurity, since a decrease in international food prices has failed to translate into more affordable food at local markets (see figure VI).

Figure VI

International food price index and consumer food price index in selected countries, 2008



Source: Millennium Development Goals Report 2009.

¹¹ Food and Agriculture Organization of the United Nations, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

¹² See UNDP, *Human Development Report 2007/2008*.

20. The response to the food security crisis, therefore, needs to address the immediate dimension of ameliorating the condition of households and populations facing hunger and undernutrition and the longer-term need to build resilience and overcome structural conditions that perpetuate food insecurity. At the international level, the 2008 food crisis galvanized the global policy community into action, and they began to mobilize political and financial support for taking ameliorative and constructive measures.

21. At the national level, the food security agenda needs to be incorporated into national sustainable development strategies. Governments need to implement measures to increase the availability of food, including raising production, and to strengthen social policies that address the negative effects of higher food prices, especially as they affect the poor.

C. Health

22. Health and development are interconnected. Insufficient development, leading to poverty and inappropriate development resulting in overconsumption, coupled with an expanding global population, together can result in severe health problems in both developing and developed countries. The linkage between health, environmental and socio-economic improvements requires intersectoral efforts.

23. Countries ought to develop plans for priority actions which are based on cooperative planning by the various levels of Government, non-governmental organizations and local communities. They should develop plans that are fully integrated into national and local sustainable development plans in order to achieve the Millennium Development Goals related to reducing child and maternal mortality and combating HIV/AIDS, malaria, tuberculosis and other diseases. However, progress in this regard could be reversed as a result of the current financial crisis (see box 2).

Box 2

Côte d'Ivoire: high prices cut health spending

In Côte d'Ivoire, poor urban people are seeking to cut down on the purchase of essential items, such as medicine. An example is the case of Drissa Kone, a man with a severe respiratory infection and a prescription for medicines that would cost CFA francs 35,000 (US\$ 83) at official prices. Drissa Kone has no hope of raising enough money to buy the medicines. His solution is to buy counterfeit medicines at Abidjan's Adjame market, where he can find an illegal reproduction of the original drug at a fraction of the price. He said: "I can buy the same medicines at the market by the individual tablet not the packet, and pay just CFA francs 150 [US\$ 0.35] per pill. For CFA francs 500 (US\$ 1.19), I can get enough medicine to last me three days!" The downside, however, concerns the quality of the medicines, as they are usually less effective than the authentic originals — a serious problem when treating potentially deadly illnesses such as malaria. Imitation medicines sometimes contain a chemical mix that further harms people's health.

Source: IRIN news service, July 2008 and Food and Agriculture Organization of the United Nations, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

24. Death in children under five years of age has declined steadily worldwide. In 2007, the global under-five mortality rate was 67 deaths per 1,000 live births, down from 93 in 1990. For the developing regions as a whole, the under-five mortality rate dropped from 103 death per 1,000 in 1990 to 74 in 2007. Still, many countries, particularly in sub-Saharan Africa (where 1 in 7 children dies before his or her fifth birthday) and South Central Asia, have made little or no progress at all.

25. Every year, 536,000 women and girls die as a result of complications during pregnancy, childbirth or the six-week period following delivery, with 99 per cent of such deaths occurring in developing countries (450 maternal deaths per 100,000 live births). Maternal deaths in sub-Saharan Africa (265,000) and in Southern Asia (187,000) together account for 85 per cent of all maternal deaths.¹³ Yet, donor funding for family planning is declining: since the mid-1990s, most developing countries have experienced a major reduction in donor funding (see figure VII).

Figure VII

Percentage change in donor assistance for family planning programmes per woman aged 15-49, 1996-2006



Source: Millennium Development Goals Report 2009.

26. Worldwide, the number of people newly infected with HIV peaked in 1996; the number has since declined to 2.7 million in 2007. These positive trends are due mostly to a decline in the annual number of new infections in some countries in Asia, Latin America and sub-Saharan Africa. Meanwhile, infection rates continue to rise in other parts of the world, especially in Eastern Europe and Central Asia. The estimated number of AIDS deaths also appears to have peaked, at 2.2 million in 2005, and has since declined to 2 million in 2007. This is partly due to increased access to antiretroviral drugs in poorer countries. Despite an overall decrease in the

¹³ IRIN news service, July 2008 and Food and Agriculture Organization of the United Nations, *The State of Food Insecurity in the World 2008: High Food Prices and Food Insecurity — Threats and Opportunities*, Rome, FAO, 2008.

number of new infections, in 2007 an estimated 33 million people were living with HIV, many of whom are children (see box 3).⁹

Box 3

The plight of children affected by AIDS

In 2007, an estimated 15 million children worldwide had lost one or both parents to AIDS; nearly 12 million of them live in sub-Saharan Africa. Responses to the plight of such children at the national level have been growing since the 1990s. By the end of 2007, national plans of action specifically for children orphaned by AIDS and other vulnerable children had been developed in 32 countries, including 29 in sub-Saharan Africa. In addition, 10 more countries — 9 in sub-Saharan Africa — were in the process of drawing up such plans. Many countries are integrating into their national development plans policies for children affected by AIDS. Since many AIDS-affected children cluster in poor households with low levels of education, helping all vulnerable children is a wise and cost-effective strategy for reaching children affected by HIV and AIDS.

Source: Millennium Development Goals Report 2009.

27. Major progress has been made in the fight against malaria in recent years, due in large part to increased funding and focus on malaria control, even though according to the World Health Organization (WHO), nearly a million people died of malaria in 2006; 95 per cent of them had lived in sub-Saharan Africa, and the vast majority comprised children under five years of age.⁹

28. The global incidence of tuberculosis, that is, the number of new cases per 100,000 persons, appears to have peaked in 2004 and is now levelling off, but the absolute number of new infections is still rising. Globally, there were an estimated 9.3 million new cases of tuberculosis in 2007, up from 9.2 million cases in 2006 and 8.3 million in 2000. Most of the cases in 2007 occurred in Asia (55 per cent) and Africa (31 per cent). Improvements in laboratory testing of cultures and drug-susceptibility testing are urgently needed, as well as in the diagnosis and treatment of multidrug-resistant tuberculosis and the implementation of joint tuberculosis-HIV initiatives are also very important.⁹

D. Education

29. The world is edging closer to the attainment of universal primary education, but too slowly to meet the 2015 target. Major breakthroughs have been achieved in sub-Saharan Africa, where enrolment increased by 15 percentage points between 2000 and 2007, and Southern Asia, which gained 11 percentage points over the same period. In many countries, improvements in school enrolment have been associated with increases in national spending on education, which could be dealt a serious blow as a result of the ongoing global financial and economic crisis. However, still a large number of children, mostly girls, are denied the right to education (see box 4).

Box 4**Worldwide 72 million children are denied the right to education**

The number of children of primary school age who are out of school has dropped by 33 million since 1999. Yet, the number not in school remains large. Almost half of the 72 million children worldwide who were denied the right to an education in 2007 live in sub-Saharan Africa, followed by South-Central Asia, home to 18 million out-of-school children. About 30 per cent of children out of school in the developing world may eventually enrol as late entrants. A further 23 per cent were previously enrolled but dropped out. The problem is magnified in sub-Saharan Africa. Not only does that region have the largest number of children out of school, but two thirds of them will probably never enrol. The same situation exists in Western Asia, where 64 per cent of the 3 million children out of school are girls. Two thirds of the millions of children out of school in South-Central Asia were enrolled at one time, but subsequently dropped out.

Source: Millennium Development Goals Report 2009.

30. Education for sustainable development is another way to improve the quality of basic education, reorient educational programmes, develop public understanding and awareness and provide training. This concept supports five fundamental types of learning in order to provide good-quality education and foster sustainable human development: learning to know, learning to be, learning to live together, learning to do and learning to transform oneself and society. The Decade of Education for Sustainable Development, adopted in 2002 by the United Nations General Assembly for the period from 2005 to 2014, is aimed at promoting sustainable skills and behaviour, inspired by creative and critical ways of thinking, in order to encourage the resolution and management of problems that stand in the way of sustainable development.

IV. Promoting sustainable agriculture and rural development

31. In the twenty-first century, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction; thus, promoting agriculture is imperative for meeting the Millennium Development Goal of halving poverty and hunger by 2015 and continuing to reduce poverty and hunger for several decades thereafter.¹⁴ Cross-country evidence shows the effect of agricultural growth on poverty reduction (see box 5).

¹⁴ World Bank, *World Development Report 2008: Agriculture for Development*, Washington, D.C., World Bank, 2007.

Box 5

Cross-country evidence of the effect of agricultural growth on poverty reduction

Among 42 developing countries over the period 1981-2003, 1 per cent of GDP growth originating in agriculture increased the expenditures of the 3 poorest deciles by at least 2.5 times as much as growth originating in the rest of the economy. Similarly, an increase in overall GDP coming from agricultural labour productivity is on average 2.9 times more effective in raising the incomes of the poorest quintile in developing countries and 2.5 times more effective for countries in Latin America than an equivalent increase in GDP coming from non-agricultural labour productivity. In focusing on absolute poverty instead and based on observations from 80 countries during the period 1980-2001, it has been shown that the comparative advantage of agriculture declined from being 2.7 times more effective in reducing the incidence of \$1-a-day poverty in the poorest quarter of countries in the sample to 2 times more effective in the richest quarter of the countries. By using cross-country regressions per region and looking at \$2-a-day poverty, larger effects from agricultural growth on poverty reduction in sub-Saharan Africa and South Asia have been reported, along with larger poverty-reducing effects of growth originating in other sectors in East Asia and in Latin America.

Source: World Bank, *World Development Report 2008: Agriculture for development*, Washington, D.C., World Bank, 2007.

32. Agriculture contributes to development in several ways. As an economic activity, agriculture can be a source of growth for the national economy, a provider of investment opportunities for the private sector and a prime driver of agriculture-related industries and the rural non-farm economy. Two thirds of the world's agricultural value added is created in developing countries. In agriculture-based countries, it generates on average 29 per cent of GDP and employs 65 per cent of the labour force.¹⁴

33. Agriculture is a source of livelihood for an estimated 86 per cent of rural people. It provides jobs for 1.3 billion smallholders and landless workers; this is because, of the developing world's 5.5 billion people, 3 billion live in rural areas. Of these rural inhabitants an estimated 2.5 billion are living in households involved in agriculture and 1.5 billion are in smallholder households.¹⁴

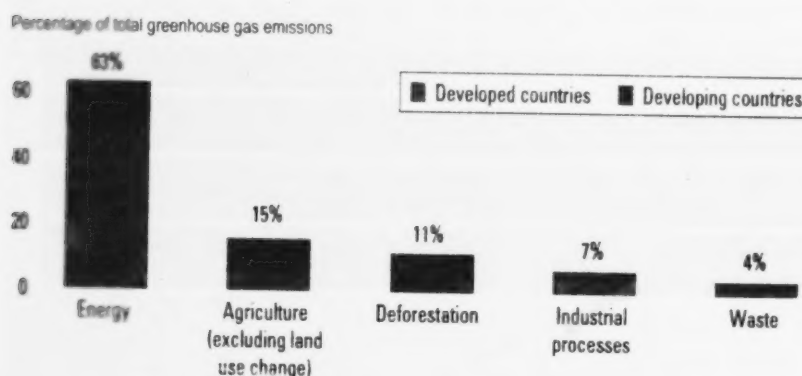
34. As a provider of environmental services, agriculture can create both good and bad environmental outcomes. It is by far the largest user of water, contributing to water scarcity, and it plays a role in agrochemical pollution, soil exhaustion and global climate change, accounting for up to 30 per cent of greenhouse gas emissions. However, it is also a major provider of environmental services, sequestering carbon, managing watersheds and preserving biodiversity. Making the farming systems of the rural poor less vulnerable to climate change is imperative.

Managing the connections among agriculture, natural resource conservation and the environment must be an integral part of using agriculture for development.¹⁵

35. Agriculture is also dependent on climate and is sensitive to climate change. The majority (about 80 per cent) of total emissions from agriculture, including deforestation, are from developing countries. The inventories of emissions that Governments submit to the United Nations Framework Convention on Climate Change¹⁶ show that agriculture and deforestation account for 11 to 15 per cent of greenhouse gas emissions (see figure VIII). On the other hand, agriculture and forestry can play a key role in tackling climate change.

Figure VIII

Agriculture and associated deforestation activities as major sources of greenhouse gas emissions



Source: World Bank, *World Development Report 2008: Agriculture for Development*, Washington, D.C., World Bank, 2007.

36. In developing countries, climate change will cause declines in the yields of the most important crops, such as rice, wheat, maize and soybeans, which will result in price increases (see figure IX). South-Central Asia will be particularly adversely affected. Thus, aggressive agricultural productivity investments of \$7.1-7.3 billion are needed to raise calorie consumption enough to offset the negative impacts of climate change on people's health and well-being.¹⁷

¹⁵ International Fund for Agricultural Development, "Climate change: a development change" (www.ifad.org/climate).

¹⁶ United Nations, *Treaty Series*, vol. 1771, No. 30822.

¹⁷ International Food Policy Research Institute (IFPRI), *Climate Change: Impact on Agriculture and Costs of Adaptation*, Washington, D.C., IFPRI, 2009.

Figure IX
Yield change between 2000 and 2050, by crop and management system: the Commonwealth Scientific and Research Organization and the National Centre for Atmospheric Research scenarios, with and without carbon dioxide fertilization

Region	No carbon dioxide fertilization		With carbon dioxide fertilization	
	Commonwealth Scientific and Research Organization	National Centre for Atmospheric Research	Commonwealth Scientific and Research Organization	National Centre for Atmospheric Research
Maize (irrigated)				
Developing countries	-2.0	-2.8	2.4	-2.1
Developed countries	-1.2	-8.7	10.5	-8.6
Maize (rainfed)				
Developing countries	1.4	-2.0	6.6	-0.4
Developed countries	0.6	-5.7	23.9	2.5
Rice (irrigated)				
Developing countries	-14.4	-18.5	2.4	-0.5
Developed countries	-3.5	-5.5	10.5	9.0
Rice (rainfed)				
Developing countries	-0.9	-0.8	6.6	6.6
Developed countries	17.7	10.8	23.9	18.3
Wheat (irrigated)				
Developing countries	-28.3	-34.3	-20.8	-27.2
Developed countries	-5.7	-4.9	-1.3	0.0
Wheat (rainfed)				
Developing countries	-1.4	-1.1	9.4	8.6
Developed countries	3.1	2.4	9.7	9.5

Source: International Food Policy Research Institute (IFPRI), *Climate Change: Impact on Agriculture and Costs of Adaptation*, Washington, D.C., IFPRI, 2009.

A. Water for sustainable agriculture, land conservation and rehabilitation, integrated land use planning and land management practices and impact on climate change

37. Agriculture is the major user of freshwater, accounting for almost 70 per cent of water withdrawal globally.¹⁸ However, a growing problem is the increasing competition for freshwater between agriculture, urban and industrial uses (see figure X), causing tension between rural and urban areas and possibly threatening regional or national food security, a situation which is exacerbated by climate change (see box 6).

¹⁸ Saroja Raman, *Agricultural Sustainability: Principles, Processes and Prospects*, New York, The Haworth Press, 2006, p. 156.

Box 6

Impact of climate change on water

Himalayan snow and ice, which provides vast amounts of water for agriculture in Asia, is expected to decline by 20 per cent by 2030 owing to the effects of climate change. China is facing severe water shortages in the northern part of the country while the southern part still has abundant water resources. By 2000, two countries (Libyan Arab Jamahiriya and Saudi Arabia) had used volumes of water for irrigation which were several times larger than their annual water resources.

Source: Food and Agriculture Organization of the United Nations, "Review of global agricultural water use per country: irrigation water withdrawal" (www.fao.org/nr/water/aquastat/water_use/index.stm).

Figure X
Sector-wise water use, by continent

Continent	Agriculture (km ³ /year)		Municipal (km ³ /year)		Industry (km ³ /year)	
	2000	2025	2000	2025	2000	2025
Africa	107	133	2.93	7.38	1.35	2.85
Asia	1 322	1 659	22.4	33.5	32.7	77.4
Europe	140	171	10.6	11	31.8	57.1
North and Central America	170	182	12.8	16.1	18.0	20.2
South America	70.8	80.9	3.7	5.6	3.4	9.9
Australia and Oceania	12.6	14.3	0.41	0.46	0.63	1.43
World	1 834	2 252	52.8	74.1	87.9	169.0

Source: Saroja Raman, *Agricultural Sustainability: Principles, Processes and Prospects*, New York, The Haworth Press, 2006.

38. The United Nations has supported the implementation of sustainable and efficient water resources development and management schemes, including integrated water resources management within each country, and, where appropriate, through international cooperation and improved irrigation efficiencies, groundwater, on-farm soil and water management practices, including for drinking water, in order to overcome water shortages, improve water quality and enhance food security.¹⁹ Many of these are win-win measures, such as developing drought- and flood-tolerant varieties, improving climate information, or planning for hydrological variability in new irrigation investments. The United Nations has selected a series of indicators to measure progress towards each goal's achievement. The World Water Assessment Programme is contributing to the task force on water (see box 7).

¹⁹ See E/2009/19.

Box 7

Benefits of land conservation and smallholder rehabilitation in Ghana

The Upper East Region of Ghana, which has the highest population density in the country, is synonymous with poor soils and erratic rainfall. Yet it has benefited from the International Fund for Agricultural Development's land conservation and smallholder rehabilitation project (1991-1997). The project was concerned mainly with mobilizing communities to sustain the results of rehabilitation and actually manage the use of water in the long term. The project enabled farmers to remain on and invest in the land, increasing local food security and reversing the cycle of neglect and land degradation that was occurring.

Source: IFAD press release (www.ifad.org/media/success/ghana.htm).

39. Climate change is also reducing significantly the quality of soil and the availability of water in many regions by increasing the variability of temperature and rainfall.²⁰ The international community needs to devise new mechanisms to provide a range of global public goods, including climate information and forecasting; research and development of crops adapted to new weather patterns; and techniques to reduce land degradation.²¹

40. Land degradation affects approximately 2 billion people living in arid zones. Without fertile soil and without tools for sustainable land management, those living in such regions are unable to break out of the cycle of poverty.²² The International Federation of Agricultural Producers (IFAP) has stated that approximately 70 per cent of the 5.2 billion hectares of agricultural arid land in Africa is degraded.²³

41. Dryland territories in at least 100 countries are prone to desertification, including developing countries in Africa, Asia and Latin America, as well as developed countries, such as Australia, the United States of America and Spain, and it is the poorest countries which suffer most since 8 out of 10 of the world's poorest countries are located in dryland areas.²⁴ Over 250 million people are directly affected by desertification, and some 1 billion are at risk. At the global level, it is estimated that the annual income foregone in the areas immediately affected by desertification amounts to approximately \$42 billion each year.²⁵

²⁰ F. N. Tubiello, J. F. Soussana and S. M. Howdan, "Climate change and food security special feature: crop and pasture response to climate change", *Proceedings of the National Academy of Science of the United States of America*, vol. 104, pp. 19686-19690.

²¹ Saroja Raman, *Agricultural Sustainability: Principles, Processes and Prospects*, New York, The Haworth Press, 2006, p. 156.

²² International Federation of Agricultural Producers, "The role of farmers in combating desertification and land degradation", AFAP Policy Statement, April 2009, p. 32.

²³ See E/CN.17/2009/10.

²⁴ United Nations, *Treaty Series*, vol. 1954, No. 33480.

²⁵ See www.unccd.int/publicinfo/factsheets/menu.php.

B. Improving farm production and farm systems

42. Improving farm production and farm systems would make agriculture more sustainable, but this would require increased efforts to include a wider audience and gain greater participation from farmers, researchers, landowners, private sector representatives, agency personnel, community members and non-profit organizations.²⁶

43. It is necessary to seek more sustainable production patterns and to enhance agriculture's provision of environmental services. Many promising technological and institutional innovations can make agriculture more sustainable with minimum trade-offs on growth and poverty reduction. Water management strategies in irrigated areas must improve water productivity. Better technologies and better ways of managing modern farm inputs can also make rain-fed farming more sustainable.

44. Strengthening property rights and providing long-term incentives for natural resource management with off-farm benefits, such as matching grants for soil conservation, are necessary in both intensive and extensive farming areas. Mitigating the effects of climate change through the sustainable management of land, forests and other natural resources should be encouraged through the provision of appropriate incentives for people in rural areas.

45. Afforestation and reforestation, better land management practices, such as conservation tillage and agroforestry rehabilitation of degraded crop and pasture land and better livestock management practices, can all contribute significantly to reducing carbon emissions.

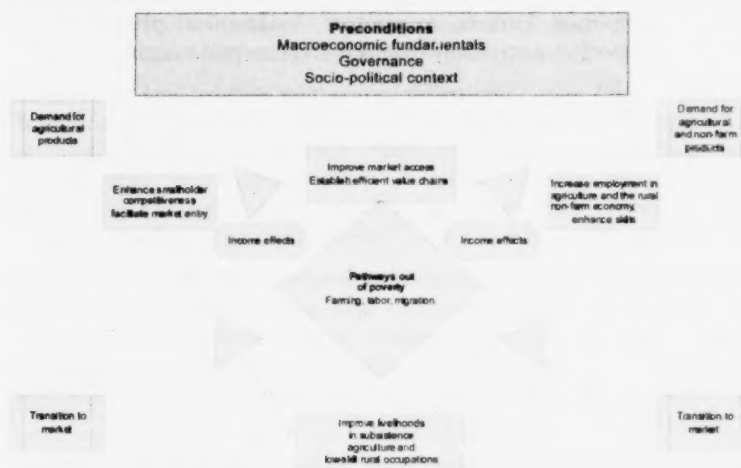
46. Many agriculture-based countries still display anaemic per capita agricultural growth (4 per cent in 2004) and little structural transformation (a declining share of agriculture in GDP and a rising share of industry and services as GDP per capita rises).¹⁴ More investment in agriculture would help to boost the potential of rural farmers to increase their productivity, thus enhancing local and national food security and accelerating poverty reduction.

47. Making agriculture more effective in supporting sustainable growth and reducing poverty starts with a favourable socio-political climate, adequate governance and sound macroeconomic fundamentals. It requires defining an agenda for each, based on a combination of four policy objectives: improve access to markets and establish efficient value chains; enhance smallholder competitiveness and facilitate market entry; improve livelihoods in subsistence farming and low-skill rural occupations; and increase employment in agriculture and the rural non-farm economy, and enhance skills (see figure XI).

²⁶ G. Digiacomo, C. J. Iremonger, L. Kemp, C. Shaik and H. Murray, *Sustainable Farming Systems: Demonstrating Environmental and Economic performance*, St. Paul, MN, United States, Minnesota Institute for Sustainable Agriculture, 2001.

Figure XI

The four policy objectives of the agriculture-for-development agenda form a policy diamond



Source: World Bank, *World Development Report 2008: Agriculture for Development*.

C. Strengthening human capacity of rural people

48. The purchasing powers of rural communities do not have to come from food-based production alone. It is therefore important to decentralize non-farm economic activity by moving it into rural areas and provide assistance to help move people out of agriculture. Doing this would call for innovative policy initiatives and strong political commitment. However, it could benefit 600 million of the world's rural poor.

49. Investment in many rural forestry resources could help in creating new jobs and providing income opportunities for people in rural areas. Education is an essential prerequisite for reducing poverty, improving agriculture and the living conditions of rural people and building a food-secure world (see boxes 8 and 9).

Box 8**Education for rural people**

The Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) have been encouraging member countries, international agencies and civil society to join the partnership known as Education for Rural People, which is part of the International Alliance against Hunger and of the Education for All initiative. Towards this end, FAO and UNESCO agreed to co-finance a partnership project to raise public awareness in Europe about the importance of education for rural people in poor countries. The project addresses the urgent need to target education in rural areas, where over 70 per cent of the world's poor are caught in the vicious cycle of being unable to access the services and opportunities that might take them out of poverty. FAO has engaged in educating boys and girls through school gardens and men and women through cooperatives, farmer field schools and broader extension programmes.

Source: Association for Cooperation in Rural Areas of Africa and Latin America, and Food and Agriculture Organization of the United Nations, capacity-building workshop on Education for Rural People and Food Security, Rome, 15-17 November 2004 (www.fao.org/sd/erp/ERPevents14_en.htm).

Box 9**Capacity-building of extension agents in Liberia**

A United Nations/Food and Agriculture Organization of the United Nations joint programme in Liberia, established for the capacity-building of extension agents and farmers, agricultural input supply and school gardens, is an effort to strengthen rural human capacity. Thus, the initiative promotes sustainable agricultural practices among agricultural professionals that work with smallholder farmers and other rural development stakeholders. Experience from developed countries and the emerging economies in Asia has shown that victory in gaining food security can be achieved if all exert efforts to build the capacity of rural communities in skills and approaches that help to link their production in order to make and generate cash income.

Source: A. Bekele, "Capacity-building for rural people in Africa: policy agenda for improved focus on capacity-building issues, strategies and actions", paper presented at Ministerial Seminar on Education for Rural People in Africa: Policy Lessons, Options and Priorities, Addis Ababa, 7-9 September 2005.

V. Energy for sustainable development

50. Energy use is closely linked with economic development, poverty reduction and the provision of vital services. Yet, energy production, distribution and consumption can have adverse effects on the local, regional and global environment. Efforts are under way across the globe to improve access to modern energy services, increase energy efficiency, reduce air pollution and shift to cleaner energy sources. The two main challenges are securing supplies of affordable and reliable energy and effecting the rapid transformation to a low-carbon efficient and environmentally benign system of energy supply, since energy is the pivotal issue at the interface of the climate and development challenges and because the energy sector, broadly defined, accounts for 60 per cent of global emissions²⁷ (see table 1 A and B).

Table 1

A. Greenhouse gas emissions by sector, 2000^a

<i>Sector</i>	<i>Megatons of carbon dioxide</i>	<i>Share (Percentage)</i>
Energy	24 731.2	59.4
Electricity and heat	10 296.0	24.7
Manufacturing and construction	4 426.5	10.6
Transportation	4 848.1	11.6
Other fuel combustion	3 563.3	8.6
Fugitive emissions	1 597.4	3.8
Industrial processes	1 369.4	3.3
Agriculture	5 729.3	13.8
Land-use change and forestry	7 618.6	18.3
Waste	1 360.5	3.3
International bunkers	829.4	2.0
Total	41 638.4	100.0

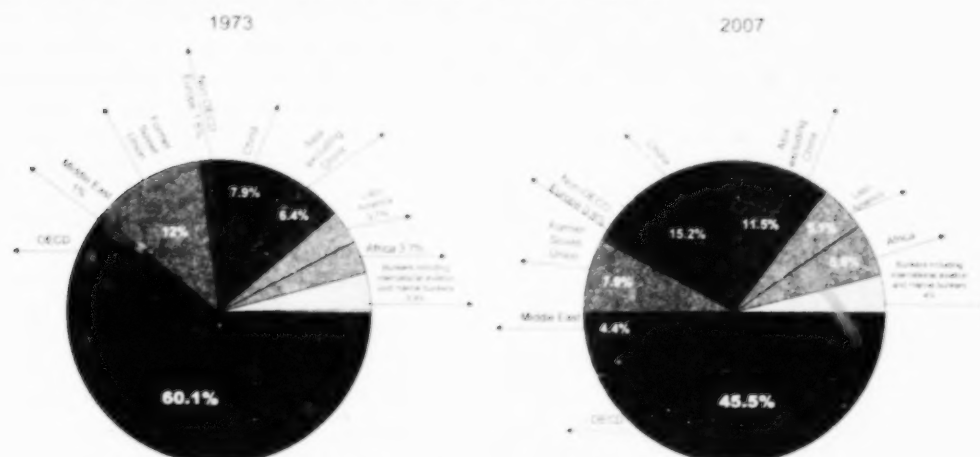
Source: Climate Analysis Indicators Tool, version 6.0, Washington, D.C., World Resources Institute, 2009, and *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.II.C.1).

Note: Data on nitrogen dioxide not available.

^a Greenhouse gases include carbon dioxide, methane, perfluorocarbons, hydrochlorofluorocarbons and sulphur hexafluoride.

²⁷ United Nations, *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.II.C.1).

B. Regional shares of total final consumption: 1973 and 2007



Source: International Energy Agency (IEA), Key World Energy Statistics, Paris, IEA, 2009.

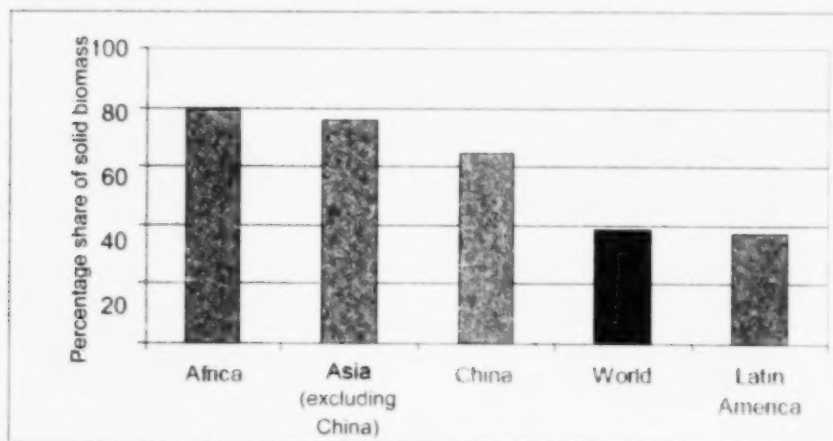
A. Access to energy services

51. Access to affordable, modern energy services is a prerequisite for the achievement of sustainable development and the Millennium Development Goals and yet modern energy services are characterized by the inequity of access, with the poor and the affluent, as well as the rural and urban areas being at the opposite ends of the scale. Indeed, about 2 billion people worldwide, one third of the world's population, are entirely without access to modern sources of energy; about 1.6 billion are without access to electricity, while 2.4 billion cook with traditional forms of biomass in the form of firewood, charcoal, manure and crop residues, which poses serious health risks, particularly as a result of indoor air pollution (see box 10). Limited access to cleaner energy services supplied by modern energy carriers is an important contributor to rising levels of poverty in some sub-Saharan African countries (see figure XII).²⁸

²⁸ United Nations, *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.II.C.1).

Figure XII

Share of solid biomass in total residential energy consumption for major regions of the world in 2006



Source: International Energy Agency, *Energy Balances of Non-OECD Countries*, 2008 edition, Paris, OECD Publishing, 2008.

Box 10

Death due to pollution

The World Health Organization estimates that 1.5 million people die each year from the effects of indoor air pollution, a number which translates into 4,000 deaths per day. In sub-Saharan Africa alone, 396,000 deaths from indoor air pollution were reported in 2002. Additionally, most biomass is collected outside of the commercial economy, imposing immense burdens on women and sometimes children, who spend considerable time collecting such material — time which therefore cannot be spent on education and employment activities.

Source: World Health Organization, *Fuel for Life: Household Energy and Health*, Geneva, WHO Press, 2006.

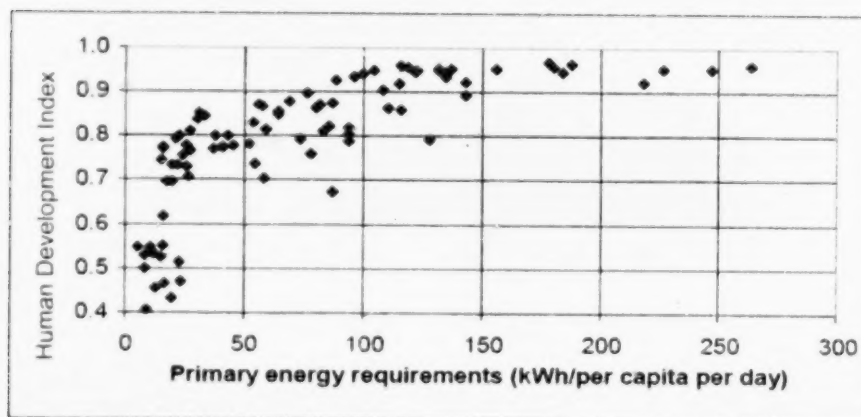
52. The experience of many countries during the past several decades shows that higher levels of development are linked to sufficiently high levels of energy consumption (see figure XIII). That relationship is demonstrated by the fact that most of the countries with a high level of development, as measured by a human development index score of at least 0.9, consume considerable amounts of energy. The populations of all countries that have reached a high level of development also have close to 100 per cent access to electricity. A global comparison of household expenditures for fuel and electricity reflects that, in many cases, developing countries, particularly those with low household incomes, have to allocate larger

shares of their income to cover energy expenditures than developed countries, making the affordability of modern energy services even more challenging.²⁹

53. However, despite the indispensable role that access to modern energy plays in sustainable development, affordability is a major constraint which can limit the use of some modern energy services in developing countries. Modern energy services that currently depend mainly on fossil fuels are not affordable for a large share of the population in some developing regions of the world. Moreover, medium and low-income economies importing fossil fuel are particularly vulnerable to price volatility and price increases, which could upset their external payments balance, cause economic instability at the macro level and prevent Governments from investing in technical and social infrastructure, resulting in higher energy costs for households.

Figure XIII

Human development index and total primary energy requirements



Source: United Nations Development Programme, *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World*, New York, UNDP, 2007.

B. Renewable and advanced energy technologies

54. Global energy demand amounted to 11,730 million tons of oil equivalent in 2006 and is expected to rise continuously in view of the projected increase in the world's population to more than 8 billion by 2030 and rapid economic expansion and industrialization, especially in countries not members of the Organization for Economic Cooperation and Development. Global energy supply still relies heavily (85 per cent) on fossil energy sources, mainly oil, gas and coal.

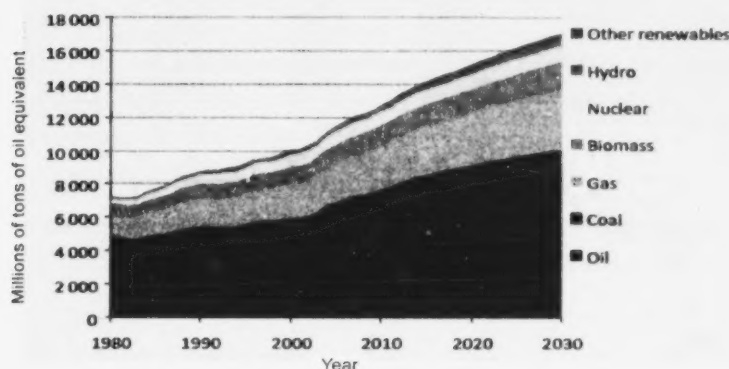
55. Deforestation and forest degradation are the primary sources of carbon emissions from some developing countries. In 2004, the forest sector accounted for the release of approximately 8.5 gigatons of carbon dioxide equivalent, mostly from deforestation, which contributes 17.4 per cent of all human-generated carbon dioxide emissions.

²⁹ United Nations Development Programme, *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World*, New York, UNDP, 2007, and International Energy Agency (IEA), *World Energy Outlook 2008*, Paris, IEA, 2008.

56. In the reference scenario of the International Energy Agency (IEA), global primary energy demand is projected to increase by 45 per cent from 2006 to 2030.³⁰ Total energy demand in non-OECD countries is foreseen to increase by 73 per cent, compared with an increase by 15 per cent in OECD countries³¹ (see figure XIV). Energy supplies would continue to be based primarily on fossil fuels, with coal projected to account for more than a third of incremental global energy demand through 2030.

Figure XIV

Global primary energy demand, by fuel, in the International Energy Agency reference scenario



Source: International Energy Agency, *World Energy Outlook 2008*, Paris, IEA, 2008.

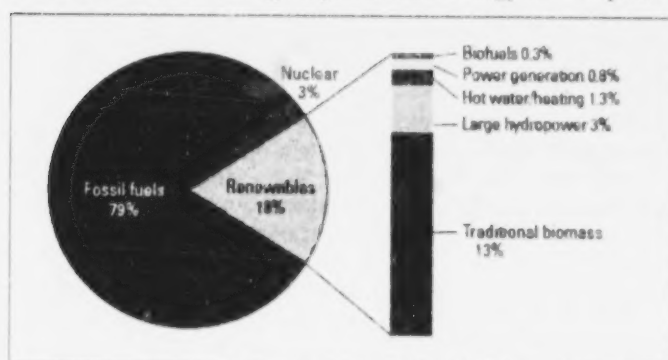
57. There has been remarkable growth and penetration of renewable forms of energy into global markets in recent years, although the share in global energy supply remains low (see figure 16). Renewable energy from wind, solar, small hydro (excluding large hydro), modern biomass (including biofuels but excluding traditional biomass) and geothermal sources supply 2.4 per cent of the world's final energy consumption. Renewable energy comprises about 5 per cent of global power-generating capacity and supplies about 3.4 per cent of global electricity generation. Wind sources currently have the largest share in renewable electric power capacity, followed by small hydro. Biomass, solar and geothermal sources provide hot water and space-heating for tens of millions of buildings. In the transportation sector, biofuels play a significant role, although their contribution is still rather small.³²

³⁰ International Energy Agency (IEA), *World Energy Outlook 2008*, Paris, IEA, 2008.

³¹ Energy Information Administration (EIA) of the United States, *International Energy Outlook 2009*, Washington D.C., EIA, 2009.

³² Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2007: Global Status Report*, Paris, REN21 Secretariat, and Washington, D.C., Worldwatch Institute, 2008.

Figure XV
Share of renewable energy in global final energy consumption



Source: Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2007: Global Status Report*, Paris, REN21 Secretariat, and Washington, D.C., Worldwatch Institute, 2008.

58. Despite this low share in global power-generating capacity, global investment in sustainable energy reached record levels in 2008, with new investments reaching US\$ 155 billion. The first three quarters of 2008 saw financial investment grow to US\$ 95 billion, 33 per cent higher than for the same period in 2007. However, owing to the financial and economic crisis, in the second half of 2008 investment declined by 17 per cent over that of the first half.³³ However, projects continued to progress and many economic stimulus bills included components for supporting renewable energy. At the same time, development assistance for renewables in developing countries expanded greatly, reaching about US\$ 2 billion in 2008. By early 2009, policy targets existed in at least 73 countries, and at least 64 countries had policies to promote renewable power generation, including 45 countries and 18 states/provinces/territories with feed-in tariffs, and many of these were recently updated (see box 11).

59. Therefore, the question is no longer whether renewables are an option. Now the question is how to integrate renewable energy into national sustainable development strategies and other comprehensive development plans that help countries to achieve their economic, environmental and social objectives in an integrated manner in order to make them more affordable, especially for developing countries. In addition to climate change mitigation, energy security and energy access, renewable energy can help countries to identify linkages between renewable energy promotion and industrial competitiveness, increasing the eco-efficiency of economies, generating employment, innovating technological advances and creating global partnerships.³⁴ A variety of complementary policy tools and measures exists

³³ United Nations Environment Programme, Sustainable Energy Finance Initiative, *The Global Financial Crisis and Its Impact on Renewable Energy Finance*, April 2009, http://sefi.unep.org/fileadmin/media/sefi/docs/publications/Study_Financial_Crisis_impact_on_RE.pdf.

³⁴ United Nations, "Addressing climate change in national sustainable development strategies: common practices", Background Paper No. 12, submitted to the Commission on Sustainable Development at its sixteenth session, New York, 5-16 May 2008.

for promoting renewable energy use. The most common policies are feed-in laws and renewable energy quotas and portfolio standards (see box 11).

Box 11

Policy support for renewables

Policy targets for renewable energy were added, supplemented, revised, or clarified in a large number of countries in 2008, along with many forms of policy support for renewables. For example, new solar photovoltaic subsidy programmes were adopted in Australia, China, Japan, Luxembourg, the Netherlands and the United States. New laws and policy provisions for renewables were adopted in developing countries: Brazil, Chile, Egypt, Mexico, the Philippines, South Africa, Syria and Uganda. New mandates for using solar hot water and other renewable forms of heating were passed in Cape Town, South Africa; Baden-Württemberg, Germany; Hawaii, United States; Norway and Poland. New mandates or targets for blending appeared in at least 11 countries, including a new 20-per cent target in India. The number of consumers of so-called green power grew to more than 5 million households and businesses worldwide. City and local government policies became a growing segment of the policy landscape, with several hundred cities and local governments around the world actively planning or implementing renewable energy policies and planning frameworks linked to efforts to reduce carbon dioxide emissions.

Source: Renewable Energy Policy Network for the 21st Century (REN21), *Renewable Global Status Report, 2009 Update*, Paris, REN21 Secretariat, 2009.

Box 12

Global feed-in-tariffs for renewable energy

Feed-in tariffs help to secure domestic energy supply, accelerate the transition to a low-carbon energy system, create new jobs and industries, guarantee investment security, drive technological and service innovation, provide fair market conditions and drive deployment faster, more equitably and cheaply than other policies.

The tariffs are legally guaranteed payments for electricity produced by green forms of energy, such as solar, wind, biomass or small hydro power, and fed into the national electricity grid. These long-term payments to operators of renewable energy installations, be they households, businesses, communities or utilities, are differentiated by scale and technology. This differentiation is based on what it actually costs to produce energy from each technology in order to ensure a reasonable profit. As costs decline and the technology nears grid parity, so do the payments. This encourages faster deployment and creates pressure on manufacturers to increase efficiency and improve overall product design and delivery. One gets paid only for the energy he or she produces; thus, the equipment must be as efficient as possible. Legal measures ensure stability and investment security. Because feed-in tariffs

ensure deployment, a mass market can be created, which continually increases technological efficiency. The system improves conditions for deployment in the developing world as people can get cheaper electrical power from solar and wind energy on site, without the necessity of a grid. The systems are often funded by a small increase in the cost of all consumers' utility bills, which makes the cost increase very minor, particularly in view of the multiple economic, social and environmental benefits. Owing to more predictable revenue streams from renewable energy projects, feed-in tariffs can attract investment. Wind power and solar photovoltaic energy especially have increased significantly as a result of feed-in tariffs.

Source: World Future Council (www.worldfuturecouncil.org/arguing_fit.html).

60. Having electricity grids that use new and renewable sources of energy would be important, but such a system should be accompanied by legal guarantees as a precondition for private-sector investments. Most countries that have undertaken recent electricity sector and market reforms now provide conditional access to the grid for independent power producers, including small-scale renewable energy producers. In liberalized electricity markets, electricity retailers seek to sell electricity from new and renewable energy sources as "green electricity", at a premium price, to environmentally conscious consumers. Many countries also use public-benefit funds to finance rural electrification, renewable energy, energy efficiency or public research projects. Other important policy tools include public competitive bidding, direct public financing and investment to promote renewable energy. In response to the financial and economic crisis, several Governments have adopted economic stimulus packages focused on the new green employment opportunities that the renewable energy sector offers. It is important that those packages be channelled into sustainable investments in renewable energy, energy efficiency and transport.³⁵

61. It is also important to underline the importance of research. Currently, the world is investing barely US\$ 2 per person per year in energy-related research, development and deployment activities. This needs to increase by a factor of 2 to 3 in order to enable the transition towards new and advanced technologies in energy systems.³⁶

C. Energy efficiency

62. Energy efficiency offers a powerful and cost-effective tool for achieving a sustainable energy future. Improvements in energy efficiency can reduce the need for investment in energy infrastructure, cut fuel costs, increase competitiveness and improve consumer welfare.

³⁵ See A/64/277.

³⁶ United Nations, *Millennium Development Goal 8: Strengthening the Global Partnership for Development in a Time of Crisis: MDG Gap Tasks Force Report 2009*. (United Nations publication, Sales No. E-09.I.8); see also website (www.un.org/esa/policy/mdggap/mdg8report_engw.pdf).

63. However, shifts in energy demand and supply according to the so-called 550 policy scenario (involving "cap-and-trade measures, sectoral agreements and national measures to keep carbon dioxide levels below 555 ppm) would require a total of US\$ 4.1 trillion more investment between 2010 and 2030 than in the "Reference Scenario", which equals on average 0.24 per cent of annual global GDP. Most of this funding would be spent on improving existing technologies. Thus, investment in power plants would US\$ 1.2 trillion higher. Additional expenditures also come from individuals who need to purchase more efficient cars, appliances and buildings. This extra cost would amount to US\$ 17 per person per year on average throughout the world, but at the same time this would lower energy bills. Improved energy efficiency lowers fossil fuel consumption by a cumulative amount of 22 million tons of oil equivalent over the period 2010-2030 and could yield cumulative savings of over US\$ 7 trillion.³⁶ Thus, a number of programmes are based on improving energy efficiency (see box 13) at the international, regional, national and local levels (see box 14).

Box 13

Global climate corps for energy efficiency

"Climate Corps" is the first programme of its kind to put the financial and analytical skills, as well as a passion for the environment, of master of business administration students to work in developing an economic rationale for energy efficiency. Recruits from top business schools undergo intensive training in fundamental energy efficiency strategies. They are then placed as "Climate Corps Fellows" at carefully selected companies which have agreed to supply a dedicated high-level project sponsor, grant access to relevant areas of the company and ultimately take action. Over the course of 10-12 weeks, the fellows develop detailed business cases from which they would make their final recommendations. The end result is a thoroughly researched set of recommendations and tools to drive the company's next steps. Results from the first year of the programme's operations demonstrate the impact of this innovative approach.

Source: Environmental Defense Fund (www.edf.org/home.cfm).

Box 14

The Equipment Energy Efficiency Programme

There is a collection of coordinated end-use energy efficiency programmes in Australia and New Zealand that provide the community with economic and environmental benefits. It focuses on programmes that require a nationally consistent framework to improve energy efficiency and reduce greenhouse gas emissions from household appliances and equipment and commercial and industrial equipment. The main tools used are mandatory minimum energy performance standards, energy efficiency labelling (enforced by law) and voluntary measures, including endorsement labelling, training and support, to promote the best products available. These tools have been used in order to improve

the energy efficiency of refrigerators and freezers. The star-rating energy label was introduced for use on refrigerators and freezers in late 1986. Energy consumption reductions were enhanced with the introduction of the standards in 1999. Between 1980 and 2006, the overall energy consumption of refrigerators was reduced by 67 per cent. In addition, the combination of labelling and standards has delivered to the market refrigerators that use one third less energy but also provide additional benefits, such as being frost-free. From 1 April 2010, a new energy label design and star-rating algorithm will have been put into force. The new algorithm is based on a function of adjusted volume to the power of 0.67 to better reflect changes in surface area by size.

64. Buildings are responsible for at least 40 per cent of energy use in most countries. There are three main approaches to energy neutrality: cutting buildings' energy demand, producing energy locally and sharing energy by creating buildings that can generate surplus energy and feed it into an intelligent grid infrastructure.³⁷

65. Efficiency gains in buildings are likely to provide the greatest energy reductions and in many cases will be the most economical option. A study by McKinsey³⁸ estimated that demand reduction measures with no net cost could almost halve expected growth in global electricity demand (see box 15).

Box 15

Energy efficiency campus in India

RETREAT is a part of the Gual Pahari campus of TERI (The Energy and Resources Institute), located about 30 km south of New Delhi. It demonstrates efficient use of natural resources, clean and renewable energy technologies and efficient waste management. The 3,000 sq metre training centre is independent of the city's electricity grid system. The peak electricity load is only 96 kW, compared with the conventional peak of 280 kW. Its design had three important aspects: the functionality of the building and how energy is used in it; "passive" concepts that minimize energy demand, such as solar orientation, latticework for shading, insulation and landscaping; and space conditioning and lighting demands that are met through energy-efficient systems using renewable energy sources.

Source: World Business Council for Sustainable Development (WBCSD), *Energy efficiency in buildings: Transforming the Market*, Geneva, WBCSD, 2009.

³⁷ World Business Council for Sustainable Development (WBCSD), *Energy Efficiency in Buildings: Transforming the Market*, Geneva, WBCSD, 2009.

³⁸ Per-Anders Enkvist, Tomas Naucclér and Jerker Rosander, "A cost curve for greenhouse gas reduction", *The McKinsey Quarterly*, No. 1, 2007.

VI. Protecting and managing the natural resource base

66. The recent financial and economic crisis that led the world into recession is not only indicative of imperfections in the global economic and financial system, but also an indication of a still-imperfect balance in the use of natural, human, social, economic and financial capital in the pursuit of sustainable development. Global economic growth over the past 50 years has been achieved at a huge cost to the environment and ecosystems. While global GDP more than doubled between 1981 and 2005, 60 per cent of the world's ecosystems have been degraded or exploited unsustainably in the meantime.³⁹ Poor management of the natural resource base in ways that consume rather than renew natural capital has crucial implications for people's livelihood and well-being.

67. Research has shown that, over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely in order to meet rapidly growing demands for food, fresh water, timber, fibre and fuel. The changes that have been made in ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of non-linear changes and the exacerbation of poverty for some groups of people. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.³⁹

68. The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially achieved if policies, institutions and practices are changed. Options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services.³⁹

69. In recent years, a significant amount of research and field programmes have been developed around the concept of "payments for ecosystem services", which seeks to create effective incentives for conservation and the sustainable use of ecosystems and the services that they provide (see box 16). At the international level, such payments can encourage transfers from the international community to countries and communities that are home to important ecosystems, where local action can provide global public goods. Gradually, mechanisms are appearing in a number of areas, such as habitat conservation, sediment control or carbon sequestration.

³⁹ Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Synthesis*, Washington D.C., Island Press, 2005.

Box 16**Clean development mechanism and payments for ecosystem services**

Through mechanisms such as the clean development mechanism set up under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (FCCC/CP/1997/7/Add.1, decision 1/CP.3, annex), the carbon market currently provides the most developed form of payments for ecosystem services operating at the international level. Projects under the clean development mechanism deliver carbon offsets in developing countries, which then receive payments from carbon emitters in developed countries. Similar approaches can and should be envisaged for a range of other ecosystem services, such as biodiversity. Further economic analysis to inform policy decision is expected to result from the ongoing work on the economics of ecosystems and biodiversity study (see <http://ec.europa.eu/environment/nature/biodiversity/economics/>) and similar initiatives at the international level.

A. Managing fragile ecosystems

70. Fragile ecosystems, such as those in drylands and coastal zones, are vulnerable to climate change but can also, if adequately protected, serve to buffer the impacts of climate change, including from extreme weather events, and facilitate adaptation. The stresses from climate change are added to those from high population density and overexploitation. Sound management practices are essential for maintaining healthy ecosystem functions in the face of such pressures.

71. Three major problems associated with mankind's management of the world's ecosystems are already causing some people significant harm, particularly the poor. Unless they are addressed, these problems will substantially diminish the long-term benefits humanity will obtain from ecosystems. First, approximately 60 per cent (15 out of 24) of the ecosystem services examined during the Millennium Ecosystem Assessment are being degraded or used unsustainably. These services include fresh water, capture fisheries, air and water purification and the regulation of regional and local climate, natural hazards and pests. Second, there is established, but incomplete, evidence that changes being made in ecosystems are increasing the likelihood of non-linear changes in ecosystems and these have important consequences for human well-being. Third, the harmful effects of the degradation of ecosystem services are being borne disproportionately by the poor, thus contributing to growing inequities and disparities across groups of people, and sometimes they are the principal factor causing poverty and social conflict.³⁹

1. Combating desertification and drought

72. Desertification is caused by climate variability and human activities while drought is mostly a result of changing weather patterns. The impact of drought is exacerbated by activities such as overgrazing and using poor cropping methods, which reduce the water retention of the soil, and improper soil conservation

techniques, which lead to soil degradation.⁴⁰ Desertification adversely affects agricultural productivity, the health of humans as well as that of livestock, and economic activities such as ecotourism (see box 17).

Box 17

Desertification and drought are at the core of serious challenges in Africa

There are extensive agricultural drylands in Africa, almost three quarters of which are already degraded to some degree (United Nations Convention to Combat Desertification: Fact sheet 11, "Combating desertification"). They are major environmental and socio-economic problems with negative effects on the livelihood of populations in many African countries. Africa's desertification is strongly linked to poverty, migration and food security, and it threatens sustainable development. The Dar-es-Salaam Declaration on Agriculture and Food Security in the SADC Region is a welcome development towards achieving sustainable management of natural resources. As a result of frequent droughts, attention is being given to programmes on drought and food security. Large investments in irrigation have resulted in the area under irrigation that grew from 1.63 million hectares in 1985 to an estimated 1.96 million hectares in 2005. In addition, investments are being made in research and development of drought-tolerant seed varieties (South African Development Community Dar-es-Salaam Declaration of Agriculture and Food Security in the SADC Region (www.sadc.int/index/browse/page/173); see also E/CN.17/2008/6).

Source: Economic Commission for Africa, *Africa Review Report on Drought and Desertification*: Section 2: "Overview of drought and desertification situation in Africa", Addis Ababa, UNECA, 2008.

73. The most obvious impact of desertification, in addition to producing widespread poverty, is the degradation of 3.3 billion hectares of the total area of rangeland, constituting 73 per cent of the rangeland with a low potential for human and animal carrying capacity; the decline in soil fertility and soil structure on about 47 per cent of the dryland areas constituting marginal rain-fed cropland; and the degradation of irrigated cropland, amounting to 30 per cent of the dryland areas with high population density and agricultural potential. Desertification is already responsible for significant forced migration; more than a billion people — one in seven of the current global population — could be forced from their homes between now and 2050 if climate change worsens.⁴¹

2. Coastal zone management

74. Coastal ecosystems across the globe continue to be threatened by urban expansion, ribbon development, poor management of watersheds and the destruction

⁴⁰ See E/CN.17/2008/6.

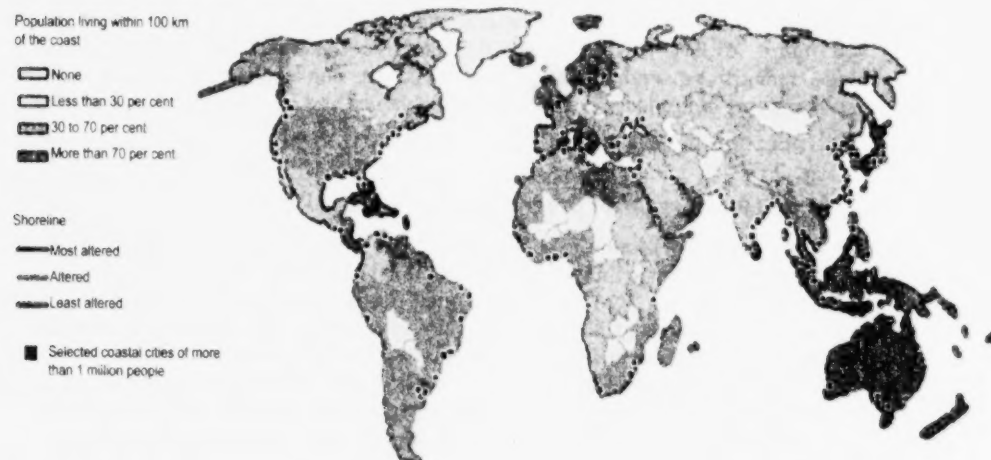
⁴¹ United Nations Convention to Combat Desertification: Fact sheet 10, "Desertification, global change, and sustainable development".

of habitat. As much as 91 per cent of all temperate and tropical coasts are likely to experience heavy impacts as a result of such development by 2050. Key threats to coastal ecosystems, including coastal plains, headlands, estuaries, deltas, intertidal zones, bays and near-shore marine waters, include oil spills, untreated sewage and industrial wastewater, heavy siltation, nutrient enrichment, invasive species, persistent organic pollutants, heavy metals, radioactive substances, marine litter, overfishing, unchecked development and the physical alteration and destruction of key coastal habitats, such as mangroves, wetlands, foreshore dune systems, coral reefs and seagrass meadows. These impacts will be compounded by a rise in sea level and acidification and the increased frequency and intensity of storms that easily break down and damage beaches and coast lines.

75. The cumulative effect of these pressures is severely reducing the productivity of coastal ecosystems vital for human life and economic development since coastal zones of the world host many activities, including industrial and business activities, fisheries, energy facilities, marine transportation, and recreation and tourist activities. According to a United States environmental report, two thirds of the world's fish catch and many marine species, depend on coastal wetlands for their survival (see figure XVI).

Figure XVI

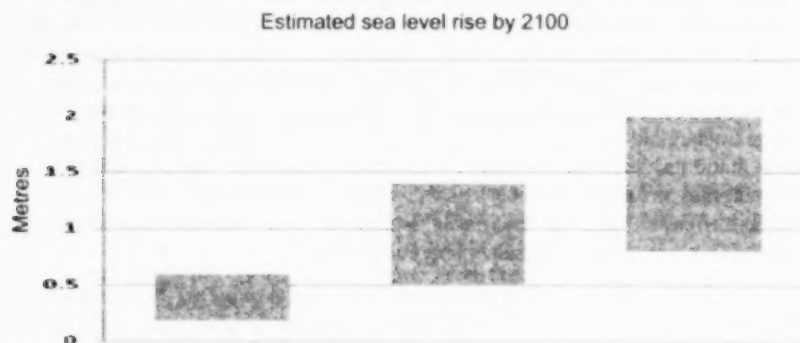
Coastal population and shoreline degradation



Source: United Nations Environment Programme.

76. Global climate change may result in flooding that would threaten lives, agriculture, livestock, buildings and infrastructure. Living within 1 metre of high tide are 8-10 million people. The Intergovernmental Panel on Climate Change (IPCC) has proven that the most vulnerable populations live in the developing world on mega deltas, small island developing States, and cities by the sea, such as Dhaka; Jakarta; Mumbai, India; and Shanghai, China. In Asia alone the number of people at risk exceeds 60 million (see also figure XVII).

Figure XVII
Comparison of recent estimates of sea level rise by 2100, relative to 1990 levels



Source: Intergovernmental Panel on Climate Change, 2007.

77. The Coastal Zone Management Subgroup of IPCC has examined the physical and institutional strategies for adapting to the potential consequences of global climate change. Coastal management programmes usually include governmental controls and private sector incentives. Vulnerable areas are managed to minimize loss of life and property through such means as setback lines, limits on population densities, minimum building elevations and coastal hazard insurance requirements (see figure XVIII). Resilient natural protective features, such as beaches, sand dunes, mangroves, wetlands and coral reefs, are conserved and enhanced, which also maintains biological diversity, aesthetic values and recreation⁴² (see box 18).

Box 18

Coastal management programme in the United States

This programme is a partnership between the Office of Ocean and Resource Management of the National Oceanic and Atmospheric Administration (NOAA) of the United States Department of Commerce and 34 coastal and Great Lakes states, territories and commonwealths. The partnership works to preserve, protect, develop and, where possible, restore and enhance the country's coastal zone resources. According to NOAA, these programmes together protect more than 99 per cent of the country's 95,331 miles of ocean and Great Lakes coastlines. As a result, tourism and recreation continue to add value to the country's fastest-growing business sectors, with some 180 million people visiting the coastal areas each year. The coastlines are home to almost 153 million people, or about 53 per cent of the total United States population. On average, about 3,600 people relocate to these coastal areas each day and, by 2015, it is estimated that the coastal population would reach 165 million.

Source: United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), Office of Ocean and Resource Management, April 2009. Accessible from <http://coastalmanagement.noaa.gov/programs/czm.html>.

⁴² Intergovernmental Panel on Climate Change (IPCC) Response Strategies Working Group, *Report of the Coastal Zone Management Subgroup of the IPCC Response Strategies Working Group*, 1990.

Figure XVIII

Estimate of marginal costs involved in protecting countries worldwide against the effects of a 1 metre sea level rise in 100 years

<i>Region</i>	<i>Total protective costs (billions of United States dollars)</i>	<i>Total costs per capita (United States dollars)</i>	<i>Annual protective costs as a percentage of GNP</i>
1 North America	106.2	306	0.03
2 South America	3.0	117	0.12
3 Caribbean islands	11.1	360	0.20
4 South America (Atlantic Ocean coast)	37.6	173	0.09
5 South America (Pacific Ocean coast)	1.7	41	0.04
6 Atlantic Ocean (small islands)	0.2	333	0.12
7 Northern and Western Europe	49.8	190	0.02
8 Baltic Sea coast	28.9	429	0.07
9 Northern Mediterranean	21.0	167	0.04
10 Southern Mediterranean	13.5	87	0.06
11 Africa (Atlantic Ocean coast)	22.8	99	0.17
12 Africa (Indian Ocean coast)	17.4	98	0.17
13 Gulf States	9.1	115	0.02
14 Asia (Indian Ocean coast)	35.9	34	0.14
15 Indian Ocean (small islands)	3.1	1 333	0.91
16 South-eastern Asia	25.3	69	0.11
17 Eastern Asia	37.6	38	0.02
18 Pacific Ocean (large islands)	35.0	1 150	0.17
19 Pacific Ocean (small islands)	3.9	1 809	0.75
20 Russian Federation	25.0	89	0.01
Total	488.1	103	0.04

Source: United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), April 2009. Accessible from <http://coastalmanagement.noaa.gov/programs/czm.html>.

78. Under the auspices of the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities⁴³ and the respective Regional Seas Conventions and Action Plans,⁴⁴ the global community has taken significant steps towards comprehensive, continuing and adaptive action to protect fragile coastal ecosystems. Particular emphasis is being placed on building national capacity to implement ecosystem-based management at the interface of land and sea, mainstreaming the protection of coastal ecosystems with national development planning and adapting to climate change.

⁴³ See www.gpa.unep.org.

⁴⁴ See www.unep.org/regionalseas.

3. Mitigation of natural disasters

79. Natural disasters have caused enormous losses in many countries and have set back economic progress in developing countries by years. Vulnerability to disasters is linked to several factors, such as population growth, unplanned development and climate change. Droughts, floods, cyclones, landslides, earthquakes and tsunamis are the major types of disaster phenomena occurring in different regions of the world.

80. Sustainable development requires that the natural resource base be protected and enhanced and that institutions be established to promote equitable growth, both factors being essential for reducing disaster hazard risk and vulnerability⁴⁵ (see figures XIX and XX). Several organizations in the United Nations system, including UNESCO, the World Meteorological Organization, WHO and UNDP are planning substantial new and continuing activities towards reducing the risk and vulnerability of natural disasters⁴⁶ (see box 19).

Box 19

Disaster reduction and risk management in Armenia, Latin America and the Caribbean and Viet Nam

In Armenia, disaster risk education is promoted in schools and through the mass media by a women's development group. This group emphasizes disaster mitigation and focuses on mothers and teachers, fostering seismic protection skills among children.

In Latin America and the Caribbean, programmes and structures for disaster risk management have been established within ministries of health.

In Viet Nam, under the National Strategy for Natural Disaster Prevention, Response and Mitigation, 36 projects will have been developed between 2009 and 2025, at a total cost of over VND 215 trillion (almost \$12 billion). According to the head of the National Steering Committee for Flood and Storm Control, since the beginning of 2010, 300 people have been killed or are missing and 963 injured by storms affecting the country, with the total damage estimated at over VND 24.4 trillion (\$1.55 billion). Knowledge related to climate change, response to storms and floods and mitigation of natural disasters will be included in school curricula.

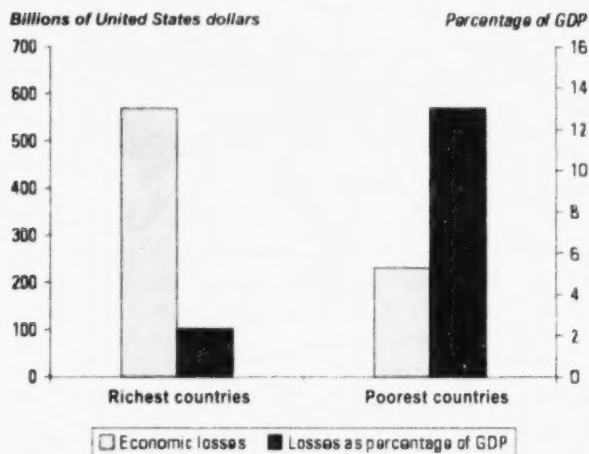
Source: United Nations International Strategy for Disaster Reduction, *Living with Risk: A Global Review of Disaster Reduction Initiatives, 2004 version* (United Nations publication, Sales No. GV.03.0.2, and World Health Organization, *World Health Report 2002*, Geneva, WHO, 2002. See also <http://files.dcp2.org/pdf/DCP/DCP61.pdf> and www.saigon-gpdaily.com.vn/National/2009/10/74961/.

⁴⁵ See EGM/NATDIS/2001/Rep.1.

⁴⁶ Frank Press and Robert M. Hamilton, "Mitigating natural disasters", editorial, *Science*, vol. 284, No. 5422, p. 1927.

Figure XIX

Disaster losses, total and as a share of GDP in the richest and poorest countries, 1985-1999



Source: United Nations International Strategy for Disaster Reduction, *Living with Risk: A Global Review of Disaster Reduction Initiatives, 2004 version* (United Nations publication, Sales No. GV.03.0.2).

Figure XX

Annual growth of GDP and occurrence of major natural disasters in Ecuador, 1980-2001

Source: United Nations International Strategy for Disaster Reduction, *Living with Risk: A Global Review of Disaster Reduction Initiatives, 2004 version* (United Nations publication, Sales No. GV.03.0.2).

81. The frequency and the intensity of disasters are expected to grow very rapidly worldwide. The risks are particularly severe in cities around the Equator, in Africa, the river deltas of South-eastern Asia, the Amazon River Basin area, low-lying islands and cities located near oceans (see figure XXI).

Figure XXI
Large cities in relation to current climate-related hazards



Source: Alexander de Sherbinin, A. Schiller and A. Pulsipher, "The vulnerability of global cities to climate hazards", *Environment and Urbanization*, vol. 19, No. 1, pp. 39-64.

Note: Hazard risk represents a cumulative score based on the risk of cyclones, floods, landslides and drought.

B. Biodiversity and conservation of biological resources

82. Many people have benefited over the last century from the exploitation of biodiversity. At the same time, however, these gains have been achieved at growing costs in the form of losses in biodiversity and the exacerbation of poverty for other groups of people. The most important direct drivers of biodiversity loss and ecosystem service changes are (a) habitat change, such as land use changes, physical modification of rivers or withdrawal of water from rivers, loss of coral reefs and damage to sea floors as a result of trawling; (b) climate change; (c) invasion of alien species; (d) overexploitation; and (e) pollution.⁴⁷ Biodiversity loss has negative effects on several aspects of human well-being, such as insecurity with regard to food and energy, vulnerability to natural disasters and difficult access to clean water and raw materials. It also adversely affects human health, social relations and freedom of choice⁴⁷ (see box 20).

Box 20

European Union battle to halt biodiversity loss

In order to achieve agreement in the European Union, Heads of State or Government have agreed on a stronger commitment "to halt the loss of Europe's biodiversity by 2010 and beyond" (Meeting of the European Council, Gothenburg, Sweden, 15 and 16 June 2001). One of the European Commission's largest contributions to the fight against biodiversity loss is the Natura 2000 network. This is now the largest ecological network in the world, consisting of around 25,000 sites spread across 27 countries and covering an area bigger than the Amazon River

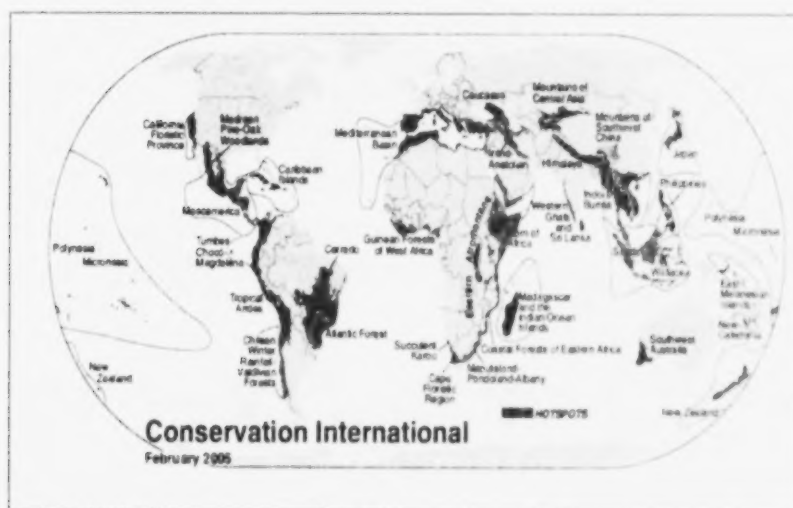
⁴⁷ GreenFacts et al., *Facts on Biodiversity: A Summary of the Millennium Ecosystem Assessment Biodiversity Synthesis* (www.greenfacts.org/en/biodiversity/biodiversity-foldout.pdf).

basin. The green infrastructure it affords serves to safeguard numerous ecosystem services and ensures that Europe's natural systems remain healthy and resilient. The network makes it possible for rare animals, such as otters, beavers and wolves, to repopulate areas from which they have been absent for centuries. It also serves to reconnect an increasingly urban society with nature (see www.europa-cu-un.org/articles/en/article_7889_en.htm).

Source: European Parliament Policy Department Economic and Scientific Policy; The Problem of Biodiversity Loss in the EU, Briefing Note 631-605.

83. Biodiversity is continuously being both generated and lost, but currently the rate of biodiversity loss exceeds the rate of creation.⁴⁸ The world's most remarkable places are also the most threatened. These are "hotspots", that is, the richest and most threatened reservoirs of plant and animal life. According to the Conservation International Report, the biodiversity hotspots hold especially high numbers of endemic species, yet their combined area of remaining habitat covers only 2.3 per cent of the Earth's land surface. Each hotspot faces extreme threats and has already lost at least 70 per cent of its original natural vegetation. Over 50 per cent of the world's plant species and 42 per cent of all terrestrial vertebrate species are endemic to 34 biodiversity hotspots⁴⁹ (see figure XXII).

Figure XXII
The world's biodiversity hotspots



Source: Conservation International, 2005.

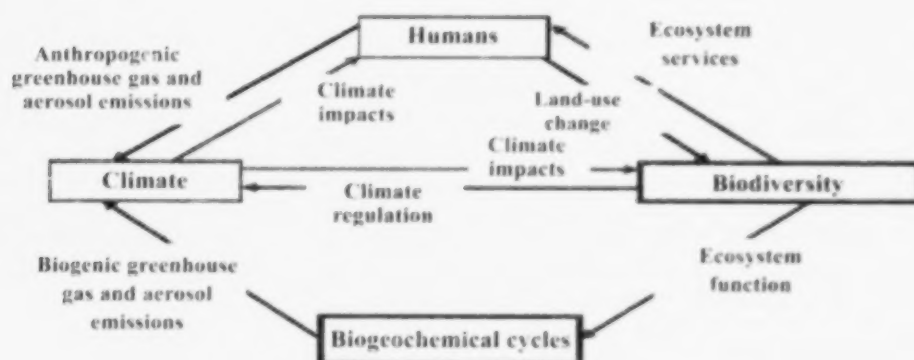
⁴⁸ UNDP, *Biodiversity and Sustainable Land Management in Europe and CIS*, <http://europeandcis.undp.org/environment/bdslm/show/FA592BD6-F203-11E1-9B37E7C4CE76751C6>.

⁴⁹ Conservation International, *The Biodiversity Hotspots* (www.conservation.org/explore/priority_areas/hotspots/pages/hotspots_main.aspx).

84. IPCC has concluded that, if temperature rises exceed the norm by 1.5-2.5°C, appropriately 20-30 per cent of the plant and animal species assessed are likely to be at risk of extinction.⁵⁰ Biodiversity is necessary for human well-being and climate regulation; therefore, it must be central to the development of adaptation and mitigation programmes (see figure XXIII). Between 12 per cent and 52 per cent of species within well-studied areas are threatened with extinction.⁵¹

Figure XXIII

Linkages between human well-being, biodiversity and climate change



Source: The Royal Society, 2008.

85. Response options to conserve biodiversity and promote human well-being have to come from all levels, global, national, regional and local, because loss of biodiversity is driven by factors at all these levels. The options also need to acknowledge the different needs of multiple stakeholders. Further progress in reducing biodiversity loss will come through greater coherence and synergies among sectoral responses and through more systematic consideration of trade-offs among ecosystem services or between biodiversity conservation and other needs of society.⁵²

C. Oceans and marine resources

86. Changes in marine ecosystems are being driven primarily by relatively small increases in ocean temperature, acidity and sea level (see figure XXIV), although other factors, such as coastal desertification and more intense storms, are placing increasing pressure on marine ecosystems.⁵³ Loss of marine habitats and biological diversity continues, with more than 10,000 species considered to be under threat.⁵²

⁵⁰ See Intergovernmental Panel on Climate Change (IPCC), R. K. Pachauri and A. Reisinger, eds., *Climate Change 2007: Synthesis Report*, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the IPCC, Geneva, IPCC, 2007.

⁵¹ The Royal Society, *Biodiversity – Climate Interactions: Adaptation, Mitigation and Human Livelihoods*, Report of an International Meeting, London, The Royal Society, 2007, p. 3.

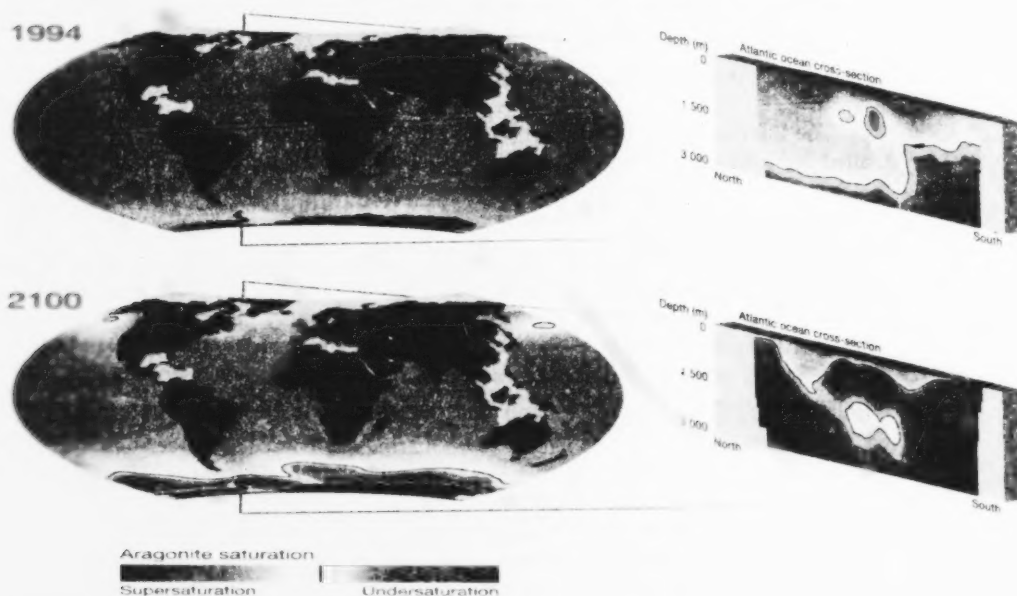
⁵² United Nations, *The United Nations Millennium Development Goals Report 2005* (United Nations publication, Sales No. E.05.I.16), p. 31.

87. Marine and coastal ecosystems are among the most productive natural environments and provide a wide range of social and economic benefits essential for human well-being in coastal countries. Furthermore, the health of the ocean, the status of the world's climate and the welfare of human societies are inextricably linked. Oceans play an important role in determining climate by transporting heat around the globe through ocean currents or sinking carbon dioxide, thereby taking it out of the atmosphere; oceans account for about 55 per cent of the world's total biological, or green, carbon captured by living organisms.

88. In turn, oceans are also highly vulnerable to changes in the world's climate. Changes in the climate and atmospheric composition are already having noticeable and devastating effects on the oceans' ecological, chemical and physical processes.

Figure XXIV

Acidification due to climate change and its impacts on oceans and coral reefs

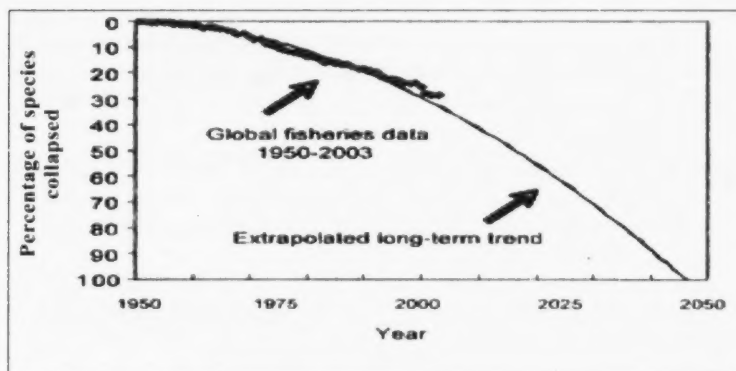


Source: United Nations Environment Programme.

89. Fisheries and other marine resources are being overexploited. The rural poor are the most immediately affected because their day-to-day subsistence and livelihood activities more often depend on the natural resources around them than is the case with other people.⁵² Since the 1950s, oceans have lost more than 90 per cent of the large fish that humans rely on for food, income and other purposes. More fish are caught now than oceans can replace⁵³ (see figure XXV).

⁵³ For example, nudibranch (*Hermisenda crassicornis*) (a species of sea slug).

Figure XXV
Global loss of seafood species



Source: Science/the Food and Agriculture Organization of the United Nations.

90. The International Maritime Organization (IMO) has joined with a host of other United Nations agencies and leading international scientific bodies in developing the first comprehensive real-time tool to assess the state of the world's oceans in order to reduce the impact of climate change on oceans and maritime resources for sustainable development.

91. IMO is also addressing GHG emissions through the development of an energy efficiency design index for new ships and a ship energy management plan for all ships, which includes guidance on best practices for fuel-efficient ship operations, and an energy efficiency operational indicator, which helps to determine the fuel efficiency of ships.⁵⁴

92. The effects of climate variabilities on marine life have been under observation for decades.⁵⁵ By 2050, ecosystems in subpolar regions, the tropics and semi-enclosed seas will have undergone numerous local extinctions. Conversely, the Arctic Ocean and the Southern Ocean will experience severe species invasions. The impacts of climate change on marine biodiversity may result in a dramatic species turnover of up to 60 per cent, according to this first quantitative estimation of marine biodiversity impacts at the global scale.⁵⁶

⁵⁴ International Maritime Organization (IMO), "Climate change a challenge to IMO too!" (www.imo.org/about/mainframe.asp?topic_id=1773&doc_id=11855).

⁵⁵ United Nations Environment Programme, *Climate Change Science Compendium 2009* (www.unep.org/compendium2009/PDF/Ch5_compendium2009.pdf), chap. 4, p. 34.

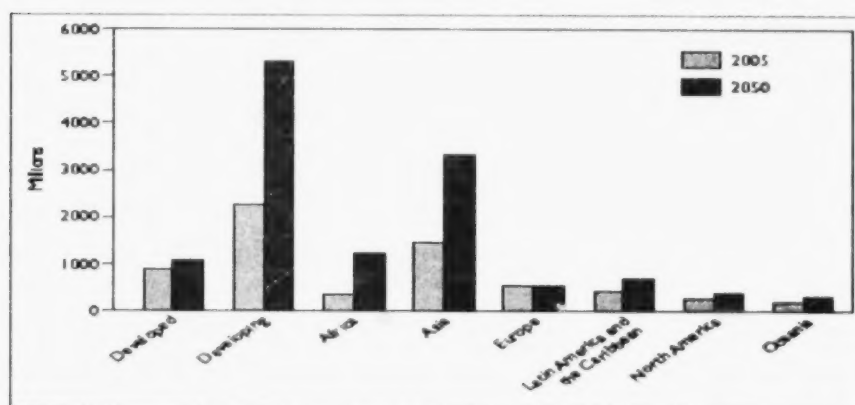
⁵⁶ W. W. L. Cheung, V. W. Y. Lam, J. L. Sarmiento, K. Kearney, R. Watson and D. Pauly, "Projecting global marine biodiversity impacts under climate change scenarios", *Fish and Fisheries*, vol. 10, No. 3, pp. 235-251.

VII. Sustainable human settlement development

93. Urbanization is rapidly increasing, especially in developing countries, the cities of which together gain an average of 5 million residents every month.⁵⁷ Over half the world's population is now living in urban centres; this trend is expected to increase so that two thirds of the world's population will be urban by 2050.⁵⁸ Up to 2030, the great majority (80 per cent) of global urban population growth is predicted to take place in developing countries, putting new pressure on urban governance and planning (see figures XXVI and XXVII).

Figure XXVI

Urban population, by region, 2005-2050



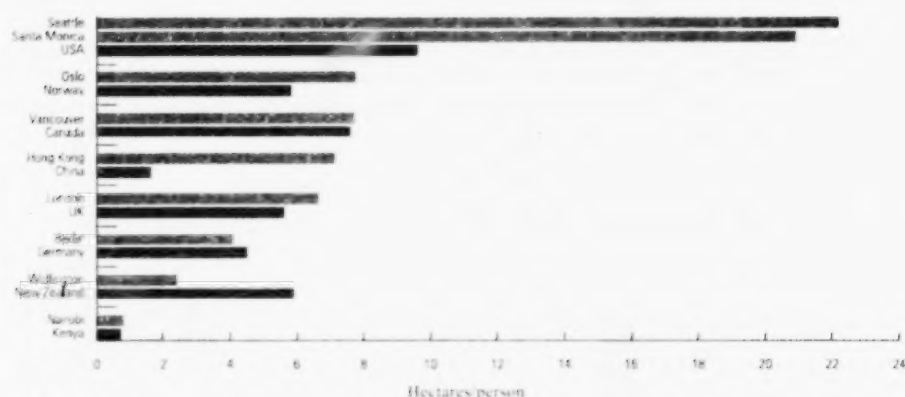
Source: UN-Habitat, *Global Report on Human Settlements 2009: Planning Sustainable Cities*, Nairobi, UN-Habitat and EarthScan, 2009.

Note: Asia not including Japan.

⁵⁷ UN-Habitat, *State of the World's Cities 2008/2009: Harmonious Cities*, Nairobi, UN-Habitat, 2008.

⁵⁸ UN-Habitat, *Global Report on Human Settlements 2009: Planning Sustainable Cities*, Nairobi, UN-Habitat and EarthScan, 2009.

Figure XXVII
**Ecological footprint of selected cities and countries/areas where
 they are located**



Source: UN-Habitat, *Global Urban Observatory 2008*.

Note: Data are from various sources.

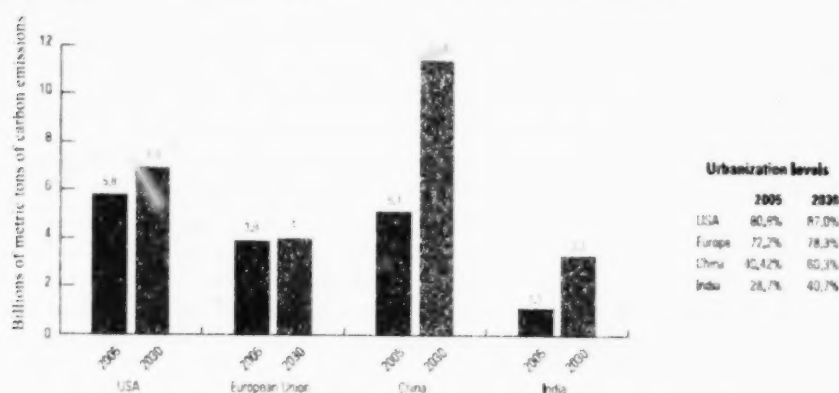
A. Climate change and urban vulnerability

94. With ongoing climate change, mankind is entering a new era of urban vulnerability. The rapid pace of urbanization along with the concentration of an ever-increasing share of the population will also significantly increase the overall vulnerability of urban areas to the impacts of global warming.

95. Rapid urbanization in developing countries holds both threats and opportunities for sustainable development. Cities furnish opportunities to use resources, including land, more efficiently while improving human well-being. Focusing on cities can also be an efficient way to address national, regional and global environmental issues.

96. However, uncontrolled urbanization can be detrimental to human well-being and socio-economic development; such urbanization is a key contributor to environmental issues inside and outside the city, such as the unsustainable use of ecosystems supplying cities with resources and the contribution of cities to global issues, such as coastal/marine pollution (see figure XXVIII).

Figure XXVIII

Carbon emissions and urbanization levels in selected economies

Source: *World Energy Outlook 2007: China and India Insights*, Paris, IEA, 2007. United Nations, *World Urbanization Prospects: The 2005 Revision* (United Nations publication, Sales No. E.06.XIII.5).

B. Intertwined nature of urbanization and infrastructure

97. Cities and urban areas function as ecosystems, with metabolisms that depend on surrounding and far-flung ecosystems, their resources and services. Infrastructural works outside cities, such as harbours, airports, waste dumps and dams, often provide cities with services and resources, and thus are closely linked with cities/urbanization. Currently, many of these forms of infrastructure are failing and are having a negative impact on human well-being and ecosystems, for example waste management and sewerage systems.

98. A city's development, that is, its access to markets and ability to foster human well-being in terms of livelihood and health, is a function of its infrastructure, which generally refers to energy, water, housing, sanitation, waste management, transit systems and food supplies.

99. Urban infrastructure in developed countries, while allowing for rapid economic expansion, has also caused significant degradation of ecosystems and the planet's environment. For example, expanded road networks have enabled urban and suburban sprawl and have led to higher demands for personal transport and fuel.

100. The key to addressing the sustainability and resilience of cities is to develop infrastructure planning, technology and systems which function in "closed loop" or "circular metabolism" systems. Such systems mimic the function of natural ecosystems by converting waste into resources and they can be applied broadly, from the design of entire urban areas to entire economies. Cities, especially megacities, in developing countries stand to gain from current innovation and experience in greening their planning and city development function.

VIII. Means of implementation

101. The global economy is currently deeply mired in the most severe financial and economic crisis since the Second World War. With its increasing impact, both in scope and depth worldwide, the crisis poses a significant threat to global economic and social development, as well as the ability of countries to attain the Millennium Development Goals and other internationally agreed development goals.

102. World gross product (WGP) is expected to have fallen in the baseline scenario by 2.6 per cent in 2009, compared with having grown positively by 2.1 per cent in 2008 and having registered an average annual growth rate of almost 4 per cent per year prior to the crisis during the period 2004-2007. While a mild recovery in WGP growth is possible for 2010, risks remain on the downside. A more prolonged global recession is possible if the vicious cycle between financial destabilization and retrenchment in the real economy cannot be sufficiently contained and farther-reaching, concerted global policy actions are not taken.

103. While the crisis originated in developed countries, which are also leading the economic downturn, developing countries are also being strongly affected through capital reversals, rising borrowing costs, collapsing global trade and commodity prices and subsiding remittance flows. In the baseline scenario, global income per capita is expected to have declined by 3.7 per cent in 2009.

104. At least 60 developing countries, of the 107 countries for which data are available, are expected to suffer declining per capita incomes, while only 7 would register per capita GDP growth of 3 per cent or higher, which is considered as the minimum required growth rate for achieving significant reductions in poverty; this represents a decline from 69 countries in 2007 but an increase over the 51 countries in 2008. Economic setbacks are expected across the board, but will be strongest in the Commonwealth of Independent States, sub-Saharan Africa and Latin America. In addition, the least developed countries will be severely affected, with growth decelerating by 3.5 percentage points from the robust growth witnessed in recent years.⁵⁹

A. Trade

105. The economic and financial crisis has had severe impacts on international trade in most countries, especially developing countries. During 2009, global trade has expectedly declined by 9 per cent. For many developing countries, the crisis is causing a decline in exports and loss of export revenue, diminishing access to trade finance, reductions in export-oriented and infrastructure investment, lower fiscal revenues and balance-of-payment problems.⁶⁰ At the same time, trade protectionism is becoming a major concern in the current financial and economic crisis. This situation has added to the already complex process of reforming global trade rules and liberalizing international trade under the Doha round of multilateral trade negotiations and other regional and bilateral initiatives.

⁵⁹ United Nations, *World Economic Situation and Prospects 2009: Update as of Mid-2009* (United Nations publication, Sales No. E.09.II.C.2).

⁶⁰ General Assembly resolution 63/303.

106. In the short-run, special attention should also be given to the financing of trade. It has been estimated that more than 90 per cent of trade is financed with some form of short-term credit, insurance or guarantee. However, in the wake of the international financial crisis this short-term credit has begun to dry up. Estimates are that the current liquidity gap in trade finance is about \$25 billion.⁶¹ Governments are encouraged to further support the development and expansion of new trade finance facilities by national export credit agencies and international financial institutions.

107. Reforming subsidies remains a key challenge to advance sustainability in the international trading system. It is estimated that the removal of agricultural protectionism could reduce global poverty by as much as 8 per cent.⁶² The removal of other subsidies, such as certain fishery and energy subsidies that are clearly harmful to the environment, should also be a priority.

108. Harnessing the potential of trade as an engine of sustainable development could contribute to overcoming the crisis and enhancing the process of change towards a greener, rules-based, open, non-discriminatory and equitable multilateral trading system.

109. Liberalization of trade in environmental goods and services could provide further impetus to green investment. In general, when promoting trade liberalization, care should be taken to avoid or reduce any negative environmental, social and economic impacts, while ensuring global development gains, as well as ways to address potential losses. One of the most effective means of achieving these positive outcomes is to strengthen domestic institutions and the regulations that govern and manage the trade liberalization process and environmental and social protection.

B. Incentives

110. The international community is in the midst of a myriad of challenges to mobilize financial resources in order to respond to the financial and economic crisis and to address climate change and other environmental emergencies, while keeping its focus on leveraging the resources needed to achieve the Millennium Development Goals.

111. A number of developed and emerging market economies have implemented fiscal stimulus packages. It has been estimated that at least 15 per cent of the global stimulus packages to date have been devoted to environmental themes, such as the promotion of renewable forms of energy and energy efficiency, sustainable forms of transportation and water and waste management. In order to achieve the desired economic effect of any fiscal stimulus, including a green one, swift implementation is required. Ensuring that such implementation is not at the expense of transparency, accountability and effectiveness demands both flexibility and creativity.⁷

⁶¹ World Trade Organization news release, "Lamy warns trade finance situation 'Deteriorating'", 12 November 2008 (www.wto.org/english/news_e/news08/e/ge_dg_stat_12nov08_e.htm).

⁶² World Bank, *Global Economic Prospects: Commodities at the Crossroads*, Washington, D.C., World Bank, 2008.

112. Further efforts are required to reorient and refocus development assistance towards the achievement of the Millennium Development Goals and the commitments of the Rio and Johannesburg Summits.⁶²

113. Growing evidence from economic research shows that opportunities exist to reorient public spending and private investment in sectors that can lead to sustainable economic growth and development, create new employment and contribute to reducing carbon dependency and ecological scarcity. Bilateral and multilateral aid donors should increase their development assistance over the next few years and target it at the sectors and actions that would promote a transition towards a green economy.

114. In addition, the international community should consider developing and expanding innovative financing mechanisms, such as the International Finance Facility, the Climate Investment Funds and Global Clean Energy, Inc., as possible means to contribute to meeting global funding requirements.

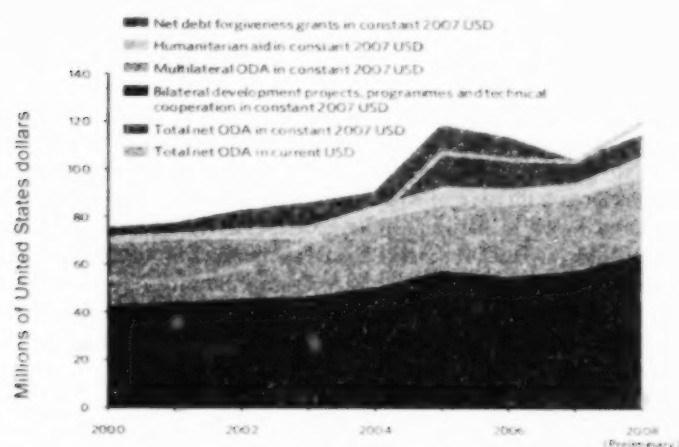
115. At the domestic level, a range of domestic policy interventions are needed to ensure that harmful policies and subsidies are reformed in order to focus investment and financing in areas that advance the objectives of sustainable development.

116. Following a decline in 2006 and 2007, official development assistance (ODA) from members of the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD/DAC) rose to \$119.8 billion in 2008, an increase of 10 per cent in real terms over that of 2007.⁶³

117. Although the share of ODA in the gross national income (GNI) of developed countries rose from 0.28 per cent in 2007 to 0.30 per cent in 2008, it remained below the 0.33 per cent reached in 2005 (see figures XXIX and XXX). Although ODA reached its highest level ever in 2008, large delivery gaps remain in meeting existing commitments. The 2010 Gleneagles target is approximately \$154 billion at current values; additional flows of \$17 billion a year would be required to achieve that ODA target. Aid to Africa reached about \$26 billion in 2008, but is still about \$20 billion short of being on track. In 2007, ODA to the least developed countries was equivalent to 0.09 per cent of the gross national income of OECD countries. However, less than half the OECD/DAC countries are meeting the 0.15-0.20 per cent target for aid to the least developed countries that was reaffirmed as part of the Programme of Action for the Least Developed Countries for the 1990s which had been adopted in Brussels in 2001.⁶⁴

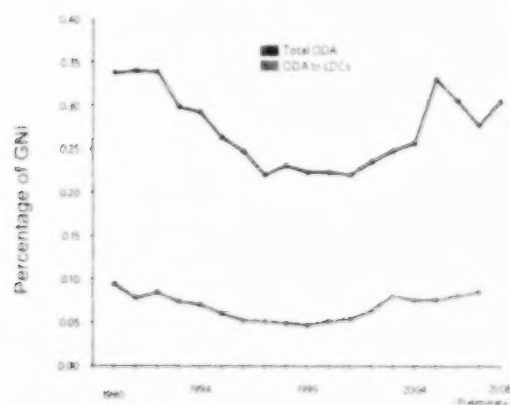
⁶³ Organization for Economic Cooperation and Development (OECD) Development Cooperation Directorate, "Development aid at its highest level ever in 2008" (www.oecd.org/document/35/0,3343,en_2649_34447_42458595_1_1_1_1,00.html).

Figure XXIX
Official development assistance from developed countries, 2000-2008



Source: Millennium Development Goals Report 2009.

Figure XXX
Net official development assistance from OECD-DAC countries as a proportion of donors' GNI, 1990-2008



Source: Millennium Development Goals Report 2009.

118. The distribution of ODA across countries is skewed; on several counts, it does not favour countries with the least means and largest numbers of poor people. By region, sub-Saharan Africa continues to be the largest recipient of ODA, having more than doubled the receipts in current dollars between 2000 and 2007. Western Asia ranks second owing to the large increase in funding for humanitarian and reconstruction purposes in Iraq. ODA flows to South-Central Asia also more than doubled over the seven-year period, largely because of the increase in assistance to Afghanistan; however, the flows remain small relative to the number of extremely poor people in that part of Asia. International assistance to South-Eastern Asia

declined during the period, even though poverty rates remain moderately high. An increase in the number of development partners, including those involved in new multilateral arrangements and South-South cooperation in addition to a range of non-governmental organizations, has contributed to the increase in assistance received by the developing countries since the adoption of the United Nations Millennium Declaration in 2000 (see General Assembly resolution 55/2).

119. An increase in the number of development partners and amount of aid has also compounded the challenge faced by recipient countries in managing development assistance. In order to maximize the benefits of international support, developing countries and their partners will have to reduce the fragmentation of this assistance and ensure that it contributes to national development strategies. The 2005 Paris Declaration on Aid Effectiveness and the 2008 Accra Agenda for Action⁶⁴ set out a number of principles and practices to guide developing countries in establishing their own strategies and partners in aligning themselves with those strategies and harmonizing actions among themselves.

120. However, ODA is not enough to achieve the internationally agreed development goals of developing countries. A genuine partnership between developed and developing countries is needed in order that the concerns of recipient countries could be met, as well as those of development partners. The development community has little choice but to continue to explore new sources of financing, innovative private-to-private sector solutions and public-private partnerships in order to mobilize additional international financing.

121. In one of the largest expansions of private capital flows to developing countries in recent decades, private medium and long-term capital flows more than tripled in size from \$195 billion in 2000 to \$670 billion in 2006. This period also saw significant diversification in the composition of private flows to developing countries, that is, for foreign direct investment, portfolio bond and equity flows, bank lending and derivative instruments⁶⁵ (see box 21).

Box 21

New sources of financing for Africa

Official aid alone will not be adequate for funding efforts to accelerate economic growth and poverty alleviation and other Millennium Development Goals in Africa, even though official development assistance is the largest source of aid for Africa. Sub-Saharan African countries need to make external finance more broad-based, attract a broader category of investors, such as pension funds and institutional investors, and expand public-private partnerships in order to raise additional external financing. Donors and international financial institutions can play an important role by furnishing guarantees, political risk insurance, help in establishing ratings and supplying advice on financial instruments, such as the securitization of remittances and

⁶⁴ A/63/539, annex.

⁶⁵ Dilip Ratha, Sanket Mohapatra and Sonia Plaza, *Beyond Aid: New Sources and Innovative Mechanisms for Financing Development in Sub-Saharan Africa*, Policy Working Paper 4609, Washington, D.C., World Bank, April 2008.

other future-flow receivables. Accessing private capital markets in a responsible manner will require a sound contractual environment, as well as credible monetary, fiscal and exchange rate policies, but ultimately the private sector will need to be the engine of growth and employment-generation. Official aid efforts must catalyse innovative financing solutions for the private sector. New sources include diaspora bonds, which are a debt instrument issued by a country, or potentially by a sub-sovereign entity, or by a private corporation, in order to raise financing from its overseas diaspora population. The stock of sub-Saharan African diaspora members is estimated to be about 16 million, with 5 million in high-income countries. Reducing remittance costs would increase remittance flows to sub-Saharan Africa, as it is believed that sub-Saharan Africa has the highest share of remittances flowing through informal channels among all regions of the world. Other innovative ways of using existing resources include recovery of flight capital and stolen assets. The cross-border flow of the global proceeds from criminal activity, corruption, and tax evasion are estimated to be more than \$1 trillion annually.

Source: World Bank.

C. Technology transfer and knowledge-sharing

122. It is not clear yet how the financial and economic crisis will influence the transfer of technology, but the need for access to new technologies is widening, especially with the recognition that urgent action will have to be undertaken in order to address the challenge of climate change. As early as 1972, the United Nations Conference on the Human Environment⁶⁶ had included explicit language emphasizing the importance of technology transfer for the achievement of environmental and developmental goals. Ever since then, the transfer of technology and knowledge-sharing have been essential components in the process of achieving sustainable development.

123. Existing best-practice technologies for a low-emissions economy are already in place in advanced economies and further breakthroughs are likely. Technology transfer is therefore a critical international public policy issue. At the same time, developing countries will need support in building their own technological capacity in order to ensure that they undergo a smooth transition to a low-emissions economy and maintain competitiveness in an open global economy.

124. In order for developing countries to be able to deal with these challenges multiplied by climate change factors, it is necessary to focus on a climate technology programme that could possibly be established under the auspices of the Conference of the Parties to the United Nations Framework Convention on Climate Change.⁶⁷ Such a programme would (a) examine the various dimensions of the technology challenge in developing countries and, where appropriate, furnish

⁶⁶ See *Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972 (A/CONF.48/14/Rev.1)*, part one, chap. I.

⁶⁷ See FCCC/C/P/2005/5.

technical assistance with respect to greening the economy; (b) establish a global research, development and deployment fund which would monitor technology development; and (c) foster a balanced intellectual property regime for technology transfer.⁶⁸

125. Knowledge-sharing, especially in today's globalized world with developed information and communication technologies, is very important for supporting sustainable development, especially in developing countries (see box 22).

126. The scientific community has done much in establishing institutions, in making professional assessment available to the general public, in developing tools for analysis (environmental impact assessment, indicators, vulnerability analysis, risk assessment, hotspots analysis, scenario analysis and valuation techniques), as well as in propagating the integrated planning and management of water, land use and energy. The scientific basis for decision-making related to sustainable development has been strengthened by the establishment of a number of institutes and "think tanks" all over the world. Another innovation from the scientific community concerns the professional assessment of the policy literature. An example is the Intergovernmental Panel on Climate Change.

Box 22

Sustainable development knowledge partnership

A noteworthy outcome of the Commission on Sustainable Development at its seventeenth session was the formation of a "sustainable development knowledge partnership" aimed at mobilizing intellectual resources in support of global and national policies and actions on sustainable development.

D. Capacity-building

127. In order to strengthen capacity-building, greater national capacities are necessary for designing national plans together with a wider involvement of non-State actors, a deeper understanding in the international community of capacity-development issues, more focus on the demands of users, improved aid coordination and donor collaboration, more capacity investments on the regional and global levels and a greater role for information technology in capacity-building.

128. Improvement has been made in this area at all levels, especially in involving non-State actors. It has been recognized that more attention is now being given to the enabling environment or the broader context of capacity-building programmes (political, social, cultural, legal and institutional) and the ways in which key stakeholders can support or prevent progress. More emphasis is being placed on the role of users and beneficiaries. Donors are becoming more supportive and facilitative (see box 23).

⁶⁸ *World Economic and Social Survey 2009: Promoting Development, Saving the Planet* (United Nations publication, Sales No. E.09.H.C.1).

Box 23

Capacity-building in Africa

The African Capacity Building Foundation, based in Harare, is an independent, capacity-building institution established in 1991 through the collaborative efforts of three multilateral institutions, namely the African Development Bank, the World Bank and the United Nations Development Programme, as well as African Governments and bilateral donors. Its objectives are to build and strengthen sustainable human and institutional capacity in the core public sector, in the sector's interface areas with the private sector and civil society, in training and research institutions, as well as within regional organizations, in order to spur economic growth, poverty reduction, good governance and effective participation by Africa in the global economy. The projects and programmes are classified into core public sector interventions, interface operations, support for regional institutions and a special intervention. The core public sector projects and programmes consist of interventions in economic policy analysis and management, economic and financial management training, financial management and accountability, public administration and management and policy analysis capacity of national parliaments. The interface operations comprise national economic

consultative councils for tripartite negotiations, networks of non-governmental organizations for dialogue and policy advocacy, public-private sector interface, support for corporate governance in the private sector and projects to reform the public sector to enable it to support the emergence of a growth-oriented private sector. At the regional level, the portfolio comprises additional operations in support of regional organizations.

Note: More about the African Capacity Building Foundation may be found at www.acbf-pact.org.

IX. Continuing challenges

129. Limited success has been achieved in bridging the gulf between different agendas regarding sustainable development. There are indications of intellectual and policy development that can help to usher in the next phase in this evolution, where the core idea of sustainable development can come into its own. The core idea is not only to integrate and combine the environment and development in a synergistic manner, but also to mainstream effectively sustainability considerations into economic and developmental decision-making and to ensure that all development actions are approached through the prism of sustainability. In return, the environment and what represents "natural capital" could act as an important driver for future economic prosperity. If sufficient resources could be invested in a greening of economies, this would not only contribute to sustainable economic growth, but also generate significant employment and reduce poverty, while lowering carbon dependency and resource scarcity.

130. The analysis suggests that the momentum towards an unsustainable future could be reversed, but only with great difficulty. It assumes fundamental shifts in desired lifestyles, values and technology. Yet, even under these assumptions, it would take many decades to realign human activity with a healthy environment, make poverty obsolete and ameliorate the deep fissures that divide people. Some climate change is irrevocable; water stress will persist in many places, extinct species will not return and lives will be lost to deprivation. Nevertheless, a planetary transition towards a humane, just and balanced ecological future is possible. However, the curve of development must be bent twice: radical revision of the technological means to begin the transition, and a reconsideration of human goals to complete it. This is the promise and the lure of the global future.⁷

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Item 3 of the provisional agenda*

Thematic cluster for the implementation cycle**2010-2011 (review session)****Review of progress achieved in implementation of Agenda 21
and the Johannesburg Plan of Implementation: transport****Report of the Secretary-General***Summary*

Transport and mobility are essential preconditions for sustainable development. While transport is often associated with environmental and social costs, the lack of adequate transport infrastructure and affordable transport services is contributing to poverty and posing major obstacles to the achievement of the Millennium Development Goals, particularly in developing countries. In addition, globally increased urbanization and motorization over the past several decades have resulted in an unprecedented rise in emissions, leading to degradation in living conditions worldwide and accelerating the process of climate change. Global population growth contributes further to these trends. Appropriate policy interventions are urgently needed to establish affordable, economically viable, socially acceptable and environmentally sound transport systems. It is crucial that multimodal systems emphasizing low-energy modes of transport be developed and that increased reliance be put on public transport systems. Integrated urban and rural transport planning, as well as supportive fiscal and regulatory policies, paired with the development of new technologies and greater international cooperation, are key factors for achieving a transport sector that meets the requirements for sustainable development.

* E/CN.17/2010/L.



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I. Introduction

1. The present report is a review of the state of implementation of the goals related to the thematic area of transport, as contained in Agenda 21,¹ the Programme for the Further Implementation of Agenda 21² and the Plan of Implementation of the World Summit on Sustainable Development (Johannesburg Plan of Implementation).³ It is designed to be considered in conjunction with the corresponding reports on chemicals, waste management, mining and the Ten-year Framework of Programmes for Sustainable Consumption and Production under the Marrakech Process, which are also before the Commission on Sustainable Development at its current session.

2. The report draws on substantive contributions from United Nations programmes and agencies, in particular the United Nations Centre for Regional Development, the United Nations Environment Programme (UNEP), the United Nations Human Settlements Programme (UN-Habitat) and the World Health Organization (WHO), and on regional assessments prepared by the five United Nations regional commissions. The United Nations Conference on Trade and Development (UNCTAD), the United Nations Development Programme (UNDP), the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) also contributed assessments in their respective sectors. Most of these organizations were also represented at the Expert Group Meeting on Transport for Sustainable Development: Analysis of trends, issues and policy options, which had been organized by the Department of Economic and Social Affairs in New York, on 27 and 28 August 2009.

3. The report also benefited from information furnished by the World Bank Group and other international financial institutions, as well as from country and national assessments submitted by Governments and from inputs of major groups.

II. Review of implementation

4. Transport and mobility are essential preconditions for economic growth, social development and global trade. However, they are also often associated with significant environmental impacts, including atmospheric pollution; thus, they pose major challenges for the achievement of sustainable development.

5. Transport is considered in chapter 7 "Promoting sustainable human settlement development" and chapter 9 "Protection of the atmosphere" of Agenda 21 and in chapter 3 "Changing unsustainable patterns of consumption and production" of the Johannesburg Plan of Implementation. Sustainable development requires a comprehensive and integrated approach to policymaking and decision-making, with a view to developing adequate, efficient, economically viable, socially acceptable and environmentally sound transport systems, as envisaged in decision 9/3

¹ *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution I, annex II.

² General Assembly resolution S-19/2, annex.

³ *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex.

"Transport", which had been adopted by the Commission on Sustainable Development at its ninth session in 2001 (see E/2001/29 and E/CN.17/2001/19), and reiterated by the World Summit on Sustainable Development in 2002.

6. Significant new challenges have emerged since the Commission reviewed transport and energy at its ninth, fourteenth and fifteenth sessions (2001, 2006 and 2007). First, for the past two years global energy markets have been highly volatile, a situation that has had significant impacts on the transport sector. Second, the recent global financial crisis and its negative impacts on employment and disposable income have led to declining demand for various goods and services, a situation which again has had significant negative economic impacts on many transport businesses and service providers. Third, recent scientific evidence of the negative impacts of anthropogenic greenhouse gas (GHG) emissions has resulted in calls for urgent global action to curb the projected growth in emissions, including those of the transport sector. Sustainable development requires very substantial investments in transport infrastructure, as well as an accelerated transition towards low-carbon transport systems.

A. Trends, facts and figures on transport

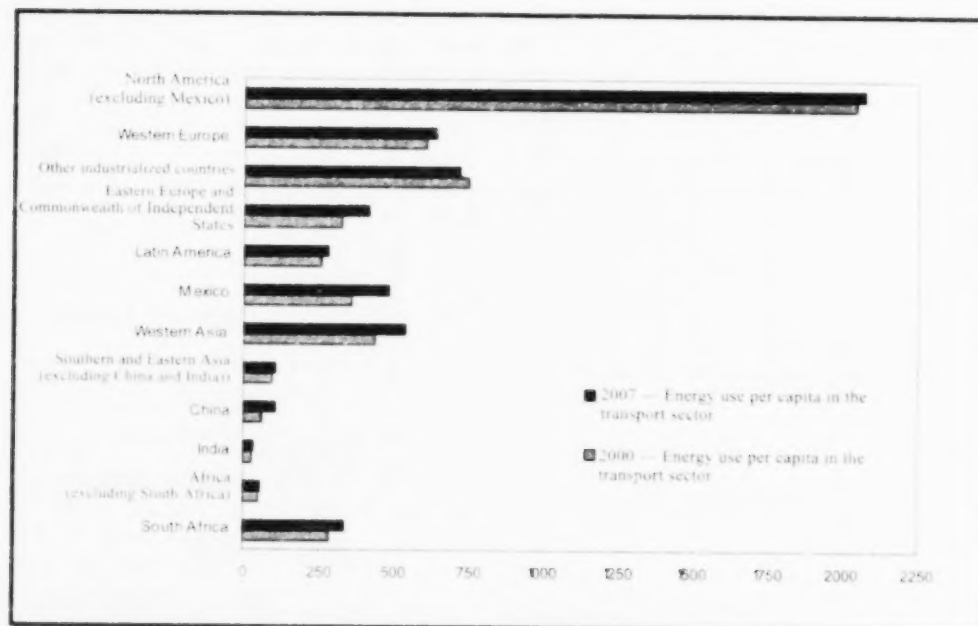
7. Economic activity, globalization, national and international trade and transport are closely interlinked. Since 1971, the use of energy for transport globally rose steadily by 2-2.5 per cent per annum, closely reflecting the global economic growth rates over that period. Road transport accounted for most of the energy used and this sector experienced the highest rate of growth in absolute terms. Aviation was the second largest user of energy; its use increased the most in relative terms.

8. Different countries and regions of the world show very diverse patterns of transport activity, with large disparities in national and per capita use of energy for transport, depending on the amount of travel undertaken, as well as on the modes of transport and types of fuels used. In North America energy consumption for transport exceeded 2,000 kilotons of oil equivalent (ktoe) per person in 2007, whereas consumption in some developing countries, such as some in Africa, averaged fewer than 100 ktoe per person annually.

9. According to data compiled by the International Energy Agency (IEA), the use of energy for transport in industrialized countries grew by an average of 1.2 per cent annually between 2000 and 2006, whereas in developing countries it increased on average by 4.3 per cent annually during the same period.

10. The transport sector relies on oil and petroleum products for more than 95 per cent of its energy needs. Gasoline and diesel are very effective transport fuels, providing high energy density and relatively easy handling characteristics. Over the past 20 years oil prices have on average been low when compared with available alternatives, a situation which contributes to a growing dependence on oil of the entire transport economy.

Figure 1
Energy use (kilotons of oil equivalent) per capita in the transport sector:
2000-2007



Source: International Energy Agency World Energy Statistics and Balances 2009
(www.iea.org/stats/index.asp).

11. Transport is responsible for an estimated 23 per cent of global energy-related GHG emissions, with motor vehicles accounting for about three quarters of that amount. Over the past decade, GHG emissions of the transport sector have increased at a faster rate than emissions of any other energy-using sector.⁴ While the average per capita transport emissions in the industrialized countries listed in annex I to the United Nations Framework Convention on Climate Change⁵ amounted to 3,283 kg of carbon dioxide equivalent (CO₂-eq) in 2007, such emissions in developing countries have been estimated to be only 356 kg of CO₂-eq for the same period.

12. From 1990 to 2005, the stock of motor vehicles globally grew by about 60 per cent, or an average of 3 per cent per year; in most countries the growth was dominated by gasoline-fuelled vehicles. The current total stock of private light-duty vehicles worldwide is estimated to be 800-900 million; it is projected to continue increasing to as many as 1.8-2.5 billion vehicles by 2020.⁶ Ownership of private motor vehicles and motorized mobility are strongly related to disposable personal

⁴ See Intergovernmental Panel on Climate Change (IPCC), Bert Metz, Ogunlade R. Davidson, Peter R. Bosch, Ratu Dave and Leo A. Meyer, eds., *Climate Change 2007: Mitigation of Climate Change*, Contribution of Working Group III to the Fourth Assessment Report of the IPCC, Cambridge, United Kingdom, and New York, Cambridge University Press, 2007.

⁵ A/AC.237/18 (Part II)/Add.1 and Corr.1, annex I.

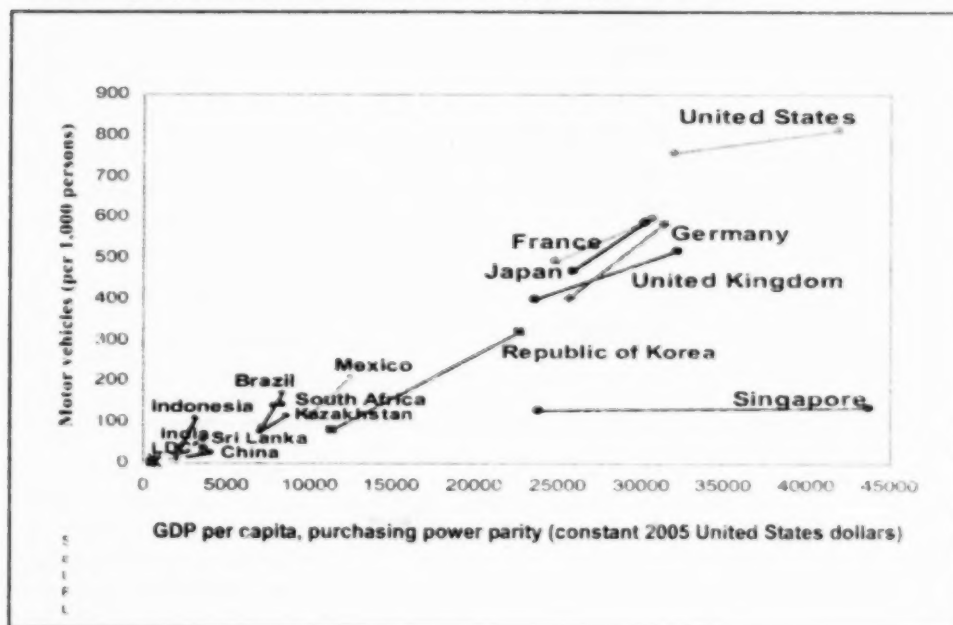
⁶ Daniel Sperling and Deborah Gordon, *Two Billion Cars: Driving toward Sustainability*, New York, Oxford University Press, 2009.

income. In almost all developing countries, ownership of private motor vehicles is still very low, and the types of vehicle used are mostly small in size and in engine capacity.

13. In spite of the rapid growth of investment in transport infrastructure, land transport indicators produced by the World Bank and others suggest that rail and road infrastructure, including bridges and tunnels, are still very inadequate in many developing countries, where often less than half the roads are paved.

Figure II

Ownership of private motor vehicles and GDP per capita: 1990-2005



Source: *World Development Indicators*, 2008.

^a Motor vehicles include cars, buses and freight vehicles but not two-wheelers.

^b Population figures refer to the mid-year population in the year for which data are available.

^c United States data are from the United States Federal Highway Administration.

^d The least developed countries included are Bangladesh, Ethiopia, Rwanda, Senegal, Sierra Leone and Uganda.

Figure III
Economic activity and motorized mobility (2006)

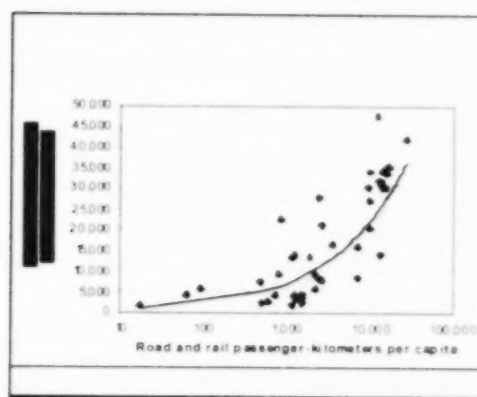
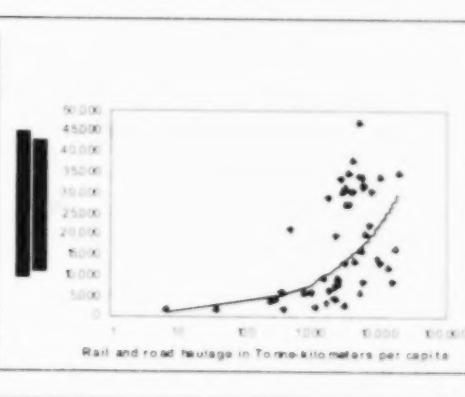


Figure IV
Economic activity and motorized freight (2006)



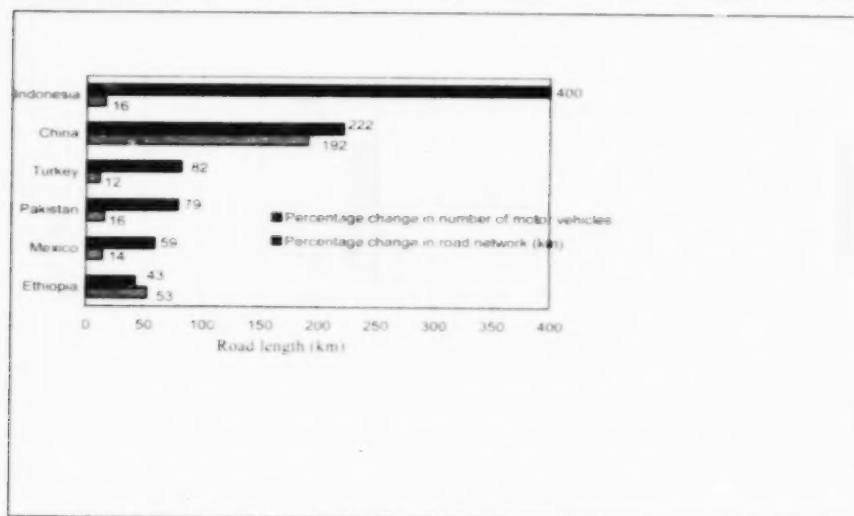
Source: World Bank, *Human Development Indicators 2008* Washington, D.C., World Bank, 2009.

14. In many low- and middle-income developing countries, road networks are increasing in length, by about 2 per cent annually on average. In India and China, the length of roads grew by some 4 and 6 per cent per annum, respectively, during the past decade. While road infrastructure remains inadequate, vehicle ownership and registration have been increasing rapidly. In the past four years, the motor vehicle population in India has grown by about 12 per cent per year and in China by about 20 per cent per year.⁷ Most of the additional vehicles are being used in large cities, further aggravating the already serious problems of traffic congestion, inefficient fuel use and high accident rates, as well as air and noise pollution. In spite of the various measures taken to control air pollution in the major cities of developing countries, ambient levels of particulate and soot pollution emitted by motor vehicles, as well as dust, are still very high and far more damaging to human health than once believed.

⁷ See World Bank, *Safe, Clean, and Affordable — Transport for Development: The World Bank Group's Transport Business Strategy for 2008-2012*, Washington, D.C., World Bank, 2008.

Figure V

Relative percentage increases in vehicle population versus road length: 1996-2006



Source: World Resources Institute, *EarthTrends 2006* and *World Development Indicators 2009*, Washington, D.C., World Bank, 2009 (www.wri.org/project/earthtrends).

Notes: Data have been taken from the latest year available within the period 2000-2006.

15. Historically, close correlation exists between GDP growth and freight growth. On average, rail systems are significantly more energy efficient in moving freight than other modes of land transport. Since 1970, the average annual growth rate for road freight measured in ton-kms has been 3.5 per cent, while that of rail transport has been only 1.1 per cent annually.

16. Whereas most industrialized countries have an extensive railway infrastructure, often with double tracks and electrification, most developing countries have systems of only limited length, often with single tracks. Several industrialized countries, as well as a number of developing countries, including China and India, have launched major programmes to modernize their railway tracks, locomotives and rolling stock; such programmes may involve the expansion or introduction of high-speed rail systems. However, most developing countries face great challenges in this regard, including financial constraints, which often delay the necessary modernization and expansion of the mostly publicly owned railways.

17. Over the past three decades air transport has grown faster than any other mode of transportation. Volumes of commercial air travel increased by an average of 5 per cent annually during the 1990s. In addition to business travel, domestic and international forms of tourism have grown into a global service industry, with many long-distance trips being undertaken by air. Since 2001, the rise in air travel has periodically been affected by security, safety and health concerns, such as the outbreak of severe acute respiratory syndrome (SARS), as well as by volatile oil prices. However, international airline passenger traffic still grew significantly, that is, by 7.9 per cent in 2007, until the financial crisis began to have an adverse impact on the industry. In 2008, 2.3 billion passengers travelled by air, with most of the travel having been within and between industrialized countries. For 2009 and the

first quarters of 2010, a 3-4 per cent decline globally in passenger travel is expected, along with operating losses for many airlines.

18. International and domestic maritime shipping has also grown rapidly, together with global trade and with the increased integration of the rapidly industrializing developing countries into the global economy. Modern vessels can carry large volumes of cargo; thus, their energy use and carbon dioxide emissions per unit of freight moved are relatively small, even if many cargo ships sail mostly empty on their return journeys. However, high sulphur emissions resulting from the use of low-cost bunker fuel are a cause of growing concern.

19. The liquefaction of natural gas for transport by tankers involves considerable energy loss. During the past 10 years national and international pipeline networks have been expanded as they provide cost-effective and environmentally benign options for long-term high-volume transport of liquid or gaseous fuels. Major new oil and gas pipelines commissioned in recent years include, among others, the Baku-Thilisi-Ceyhan pipeline (from Azerbaijan through Georgia to Turkey), the Kenkiyak-Kumkol pipeline (from Kazakhstan to China), the Rockies Express natural gas pipeline system in the United States of America and the Trans-Panama oil pipeline in Panama. Several other large-scale projects are under consideration, including gas pipelines from Myanmar to China from West Asia to India, from the Russian Federation to China and from North Africa to Europe. The eventual completion of their construction may significantly alleviate the increasing bottlenecks in international shipping.

20. Geographical conditions can pose particular disadvantages with regard to the development of transport infrastructure. Many of the small island developing States often experience transport and trading cost disadvantages as the volumes of their maritime and other transport services are often comparatively small. Similarly, some mountainous and landlocked countries also face particular challenges in the development of transport infrastructure and in their participation in international trade and travel. For many landlocked least developed countries in sub-Saharan Africa, their prospects for economic development are constrained by high transport costs.

21. Transport and related industries, including the automobile industry, and employment in these sectors have been seriously affected by the current global financial and economic crisis. The crisis has caused significant decreases in global production and international trade in 2008 and 2009, first in the developed countries and then in developing countries. Exports from developing countries in the Asian and Pacific region have been among the most seriously affected, declining by 26 per cent.⁸

22. Impacts of the financial crisis on maritime transport and the shipbuilding and ship-operating industries have been analysed by UNCTAD. Recent postponements and cancellations of shipbuilding contracts may have major impacts on shipbuilding countries, such as China, the Republic of Korea and Viet Nam, while intensified scrapping of older tonnage may pose further challenges for safety, health and environmental conditions in major ship-breaking countries, such as Bangladesh and Pakistan.

⁸ World Trade Organization, *World Trade Report 2009: Trade Policy Commitments and Contingency Measures*, Geneva, WTO, 2009.

23. Cruise shipping is a rapidly growing tourist industry that has been less affected by the financial crisis than the previously mentioned industries. Cruise Lines International Association has estimated that some 13.5 million passengers, mostly from North America, would take a cruise ship holiday in 2009. Large cruise ships can accommodate 3,000 to 6,000 passengers. However, such vessels generate a number of waste streams that can result in discharges into the marine environment; these include sewage, grey water, oily bilge water, ballast water, solid waste and hazardous waste. If not properly treated and disposed of, such wastes can become a significant source of pathogens, nutrients and toxic substances potentially threatening to human health and aquatic life, particularly in environmentally pristine coastal areas.

24. A variety of models and scenario projections have been developed by IEA, the World Energy Council, the Stockholm Environment Institute, the World Business Council for Sustainable Development and other organizations that project transport demand, necessary investments, energy needs and the associated increases in GHG emissions and impacts on the process of climate change for the intermediate and long-term future to 2030, 2050 and 2100. Many model calculations made before the start of the recent financial crisis did not anticipate such a situation and therefore may need to be adjusted. However, most model and trend analysts agree that the global economy is on a path to roughly double, or even triple, its energy use and carbon dioxide emissions by 2050 unless decisive policy interventions are made soon.

B. Rural transport infrastructure and lack of access to transport services in developing countries

25. Inadequate transport infrastructure and lack of access to affordable transport services are often cited as factors that perpetuate poverty while posing major obstacles to countries' progress towards the achievement of the Millennium Development Goals, particularly in rural areas. According to World Bank estimates⁹ more than 1 billion people living in rural areas still do not have access to adequate transport and 98 per cent of them are in developing countries.

26. Physical isolation is a strong contributor to poverty and the marginalization of rural communities. Small-scale and subsistence farmers, women and children are particularly affected. A disproportionate burden is placed on rural women, especially those living in regions of sub-Saharan Africa, who spend a major part of the day in travel and transport just to meet household subsistence needs.

⁹ The World Bank Rural Access Index measures the number of people in rural areas who live within 2 km (typically equivalent to a 20-25-minute walk) of an all-weather road as a proportion of the total population.

Box 1

Positive impact of rural transport and enhanced mobility on the achievement of the Millennium Development Goals**Goal 1:**

Eradicate extreme poverty and hunger

- Facilitates access to job opportunities and markets
- Improves food security by increasing (agricultural) production and distribution efficiency
- Lowers agricultural input prices
- Reduces the monopoly power of (agricultural) traders/middlemen

Goal 2:

Achieve universal primary education

- Facilitates or enables access to education facilities and literacy
- Prevents isolation of rural communities, attracts teachers
- Relieves travel time for domestic tasks (barrier to attendance, particularly for girls)

Goal 3:

Promote gender equality and empower women

- Decreases time for women's daily chores (e.g. water collection)
- Empowers women to take more control over their lives by increasing their access to markets, their exposure to education and information and their opportunities to participate in income-generation, community and political activities
- Levels the balance of equality in gender relations

Goal 4:

Reduce child mortality

- Facilitates access to health facilities and services (e.g. skilled birth attendants), medicines and supplies

Goal 5:

Improve maternal health

- Enables health educators to visit communities more frequently
- Enables education, vaccination, disease prevention campaigns
- Makes possible the safe and timely delivery of vaccines

Goal 6:

Combat HIV/AIDS, malaria and other diseases

- Provides access to safe and clean water that enhances hygiene
- Reduces critical secondary injuries during transportation (particularly for pregnant women)
- Increases health-care-seeking behaviour of communities

Goal 7:

Ensure environmental sustainability

- Enables waste management
- Facilitates access to natural resources
- Supports (natural) disaster management and rehabilitation activities

Goal 8:

Develop a global partnership for development

- Attracts visitors, tourists and investors
- Empowers communities and individuals through mobility
- Supports political mobilization and interaction with governmental representatives

Source: Adapted from International Forum for Rural Transport and Development (www.ifrtd.org/mdgs.htm).

27. Rural roads are characterized by light traffic (fewer than 50 vehicles per day) and include engineered roads and bridges, as well as trafficable tracks and trails. The main purpose of people taking trips in rural areas is to buy provisions, sell crops/products, pursue education, process agricultural products, fetch water, collect fuel wood, access medical care, visit family and friends, commute to places of work and obtain official documentation. The most commonly used transport modes remain motorcycles, bicycles, barrows, carts, small boats and walking, often with goods loaded on the back or head. Owing to low population densities in remote rural areas, adequate public transport services are rarely available.

28. As demonstrated by the success of the large-scale rural roads project sponsored by the Government of India and the World Bank, basic rural transport infrastructure and services can significantly improve rural farm and non-farm incomes. The project for the period 2004-2010 is aimed at connecting all villages with more than 500 people, that is, a total of about 180,000 villages in certain states, utilizing new or improved all-weather roads. In many villages, household incomes have risen by 50-100 per cent on average as a result of the project. In many states, the project has enabled increased agricultural yields and productivity, improved literacy and diversification of the rural economy. Farmers receive better prices for their products when they can access markets directly, thus cutting out middlemen and reducing the spoilage of perishable products.

29. The impact of rural road programmes on rural employment and income generation can be ensured through the use of appropriate technologies, local contractors, local workers and local materials. Disaster relief and food-for-work types of transport infrastructure project can also contribute to rural poverty reduction.

Box 2

Small-scale and self-help projects in developing rural transport

Sri Lanka: Community bus project: In Ratnapura district, people in three villages worked with the Lanka Forum for Rural Transport and Development and Practical Action (formerly the Intermediate Technology Development Group) to introduce a community bus service. After a decade, villagers enjoy newer bus and improved road conditions as they continue to benefit from cheaper and more reliable access to the local school, health centre and market.

Nepal: Bicycle ambulances: For several remote communities, bicycle ambulances provide people with a vital lifeline, enabling farmers to reach medical centres more quickly.

Guatemala: Labour-based road-building: In an effort to improve rural access, the Government of Guatemala conducted a programme to construct, rehabilitate and maintain rural roads, using labour-based work methods. This programme resulted in the building of 2,100 km of rural roads.

Ghana: Women market traders in the driving seat: A Transaid project in Accra is assisting market women to own, manage and control their own fleet of small vans to help reduce the transport burden they face. The women are trained to drive, maintain and implement cost-effectively their own transport management system.

Zambia: Community-driven market access roads: A project financed by the International Fund for Agricultural Development and the Government of Zambia to design and construct improved market access roads is benefiting thousands of villagers in southern Zambia through improved food security, employment for women and improved safety of schoolchildren.

Azerbaijan: Road rehabilitation makes economic growth accessible for remote communities: With the support of the United States Agency for International Development, seven village communities in Lerik district formed a community development council and initiated work to expand and rehabilitate more than 12 km of road surface.

Source: Practical Action, United States Agency for International Development, Transaid and International Fund for Agricultural Development, among others.

30. Although many successful rural transport projects and programmes have been implemented in all regions of the world, including the Sub-Saharan Africa Transport Policy Programme of the World Bank and the Economic Commission for Africa (ECA) in Africa, significant additional investments in rural infrastructure and transport systems are crucial for improving the living conditions of rural populations. As shown in the examples in box 2, even small investments can make great differences in the lives of the rural poor, but larger programmes with public and international funding are needed to overcome the widening development gap. The importance of the principle of increasing the access of people in rural areas to transport infrastructure and services was also highlighted by the Forum of Asian Ministers of Transport at its first session held at the ESCAP secretariat in Bangkok on 17 and 18 December 2009.¹⁰

C. Urban transport

31. In Agenda 21, all countries were called upon to (a) integrate land use and transportation planning in order to encourage development patterns that reduce transport demand; (b) adopt urban transport programmes favouring high occupancy, as appropriate; (c) encourage non-motorized modes of transport by furnishing safe cycleways and footways in urban and suburban centres in countries, as appropriate; (d) devote particular attention to effective traffic management, efficient operation of public transport and maintenance of public infrastructure; (e) promote the exchange of information among countries and representatives of local and metropolitan areas; and (f) re-evaluate current consumption and production patterns in order to reduce the use of energy and natural resources.

¹⁰ Bangkok Declaration on Transport Development in Asia.

32. Urban transport poses great challenges in many of the rapidly growing metropolitan and other urban areas of developing countries where lack of adequate planning and public transport services causes economic losses due to high consumption of fuels, congestion and air pollution caused by sulphur oxides, nitrogen oxides, volatile organic compounds and particulates, with their associated impacts on public health. According to UN-Habitat projections, by 2050, two thirds of humanity will live in towns and cities. Hence, cities in developing countries urgently need affordable high-quality public urban transport systems.

33. Urban planners face the challenge of balancing an appropriate separation and mix of residential, industrial, commercial and recreation zones so that jobs, markets and residences would not be separated by long distances. Adequate provision of safe routes for cycles and parking facilities could enhance sustainability in urban transport systems. Similarly, policies to support walking as a prime mode of transport through the provision and maintenance of walkways could also be effective in urban areas. Many European cities and towns have successfully restricted motor vehicle use in commercial centres by introducing pedestrian-only shopping zones.

34. Subway and light-rail systems form the basis for rapid, cost-effective and environmentally benign urban passenger transport. For example, 116 cities, located mostly in the industrialized countries, operate their own metro systems, which are used by an estimated 155 million passengers each day. In addition, there are about 400 light-rail systems worldwide, while over 200 new systems are being planned. However, the construction of subways in existing cities poses major challenges and is often a very costly undertaking, and thus not easily affordable for developing countries, even though tunnel construction technologies are now very advanced.

35. A growing number of cities in developing countries (see also the annex to the presented report) have embarked on, or are considering, the introduction of bus rapid transit (BRT) systems, which are characterized mostly by larger buses that run on segregated lanes parallel to the local traffic. In comparison with light-rail transit or subway systems, BRT systems are much less costly while still achieving comparable high transport efficiency. Enhanced BRT systems offer climate-controlled buses with platform-level entry, pre- or post-fare payment and global positioning systems to inform customers of expected waiting times and transfer connections. Modern BRT systems can move up to 45,000 passengers per hour along a single route direction compared with fewer than 10,000 passengers for mixed traffic on the same corridor.

36. Bus rapid transit and other urban public transport systems offer many direct and indirect local, national and global benefits. A recent study for Mexico City, in which the costs and benefits of a BRT system were estimated and monetized, demonstrated that the sum of public benefits, including economic time saved and health and fuel costs avoided, by far exceeded the costs of BRT systems. In addition, BRT and other public transport infrastructure investments help to avert the emissions of significant amounts of GHG. Several initiatives, including the international Partnership on Sustainable Low Carbon Transport, and studies have been launched recently to explore the possibility of eventually including BRT and other public transport projects in nationally appropriate mitigation actions in a future climate change agreement and emissions trading system.

37. Although the costs of individual buses and BRT systems are moderate, many such systems are urgently needed to enable developing countries to tackle growing urban transport problems. For many developing countries, BRT systems would be affordable only if they attract significant international technical and financial support.

38. The private sector and public-private partnerships can play an important role in financing and managing urban public transport systems. At the same time, the promotion of public transport can be successful only if fares remain affordable, including for the urban poor. This implies that public transport operators may have to be subsidized or remunerated for the public health, socio-economic and environmental benefits that they generate.

39. A growing number of developing countries are dedicating their various capacities to produce or assemble buses domestically. Perspectives for greater North-South and South-South cooperation could be explored, with a view to improving quality and realizing further cost reductions.

40. Area licensing, road pricing and parking charge schemes, such as those applied in Singapore, London and Paris, have proven effective in terms of reducing urban vehicular traffic. Some cities, particularly those where air pollution poses a major threat to human health, have implemented temporary restrictions on the use of cars, such as by certain days of the week, numbers on licence plates or minimum passenger occupancy. Public information and public health campaigns advocating car-free days or temporary road closures for biking, walking or street markets have also become increasingly popular.

41. In a growing number of cities, new urban planning and innovative business concepts, including car-free housing, car-sharing, short-term car rentals¹¹ and "dial-a-ride" services, as well as company bicycles and urban bicycle rental schemes, are offering new low-carbon transport options. In many capitals and most larger cities in Europe, bicycles are now easily available for rent at major train or subway stations.

42. Since the adoption in 2006 of the Convention on the Rights of Persons with Disabilities¹² transport planners in many countries have initiated additional projects and programmes to provide persons with disabilities better and more equal and affordable access to transport and personal mobility, particularly in urban public transport systems.

D. Integrated planning of regional, inter-urban and cross-border transport systems

43. A three-pronged approach is recommended for making transport systems more sustainable. The first prong is to avoid unnecessary transport through better spatial planning and other measures. In the Netherlands, a new multi-stakeholder partnership involving a group of large corporations set an example in reducing traffic congestion and the associated waste of time and energy by staggering work hours for employees and by introducing telecommuting and videoconferencing. As a

¹¹ For example, www.zazcar.com.br (Brazil), www.zipcar.com (United States of America), www.dbcarsharing.de (Germany).

¹² See General Assembly resolution 61/106.

result, traffic volume and congestion have been reduced in several cities, particularly during rush hour.

44. The second prong relates to the promotion of modal shifts, favouring transport modes with high transport and fuel efficiency, such as high-speed passenger trains or rail and barge freight on inland waterways. In Europe and Japan, the average energy consumption per passenger-kilometre for high-speed rail transport is generally one third to one fifth lower than that for airplane or car use. Freight transported by truck is more versatile and flexible than other means; therefore, it is the preferred mode for transporting many types of goods. Nonetheless, in many countries shifting freight from road to rail, where possible, may increasingly be in the public interest in view of the environmental advantages that such a shift would entail.¹³ Optimization of the necessary infrastructure for intermodal integration of rail and road, together with ports and airports, offers considerable challenges, as well as opportunities for the realization of economic, social and environmental benefits.

45. The third prong is to improve efficiency for all modes of transport that contribute significantly to reductions in emissions and air pollution while saving energy. Section G of the present report elaborates the various regulatory and fiscal policy tools available to promote modal shifts, increase fuel economy and efficiency and enhance the internalization and reduction of negative environmental effects.

E. Transport safety

46. Comprehensive periodical assessments of the global status of road safety are conducted by WHO.¹⁴ Worldwide, an estimated 1.2 million people are killed in road accidents each year and as many as 50 million are injured, with about 90 per cent of such accidents occurring in low- and middle-income countries.

47. Separating different modes of transport through appropriate infrastructure and, where possible, through crossing-free intersections can greatly reduce the number of traffic-related accidents. Road safety concerns need to be fully integrated into transport planning. Permanent, seasonal or other temporary speed limits, driver safety and ecotraining programmes, mandatory seat-belt or cycling-helmet requirements and public awareness campaigns are all proven tools for preventing accidents and serious injuries.

48. In resolution 62/244, the General Assembly welcomed the offer of the Government of the Russian Federation to host a global ministerial conference on road safety; the conference, the first of its kind, was held in Moscow on 19 and 20 November 2009. In its declaration, the conference called upon the General Assembly to declare the period 2011-2020 as the "decade of action for road safety".

¹³ See, for example, the European Union programme promoting modal shift at http://ec.europa.eu/transport/marcopolo/home/home_en.htm.

¹⁴ World Health Organization, *Global Status Report on Road Safety: Time for Action*, Geneva, WHO, 2009.

F. Transport and climate change

49. The transport sector is responsible for almost a quarter of the emissions of GHGs from fossil fuel sources and it is the fastest-growing sector with respect to such emissions, yet international climate initiatives and support programmes have paid little attention to these factors.

50. Whereas GHG emissions in some other economic sectors decreased slightly between 1990 and 2007, emissions from transport in the industrialized countries listed as Annex 1 Parties to the United Nations Framework Convention on Climate Change have increased significantly, that is by 17 per cent on average. Hence, as a group, Annex 1 Country Parties to the Convention are not likely to achieve the emission reduction targets agreed under the Kyoto Protocol.¹⁵

51. In 2006, aggregate global emissions of carbon dioxide from the transport sector were over 6.45 gigatons of carbon dioxide. Road transport accounted for 73 per cent of these emissions, aviation for 11 per cent, international shipping for 9 per cent, inland navigation for 2 per cent, rail for 2 per cent and other traffic for the remaining 3 per cent. Transport also accounts for a large share of black carbon particulate emissions, which can also contribute significantly to the process of climate change.¹⁶

52. Motor vehicle fuel economy and emission standards offer important policy options for mitigating the effects of climate change. Existing regulatory approaches differ considerably among countries, depending on technical definitions of standards, vehicle categories and weight classes, as well as test-driving cycles. Several countries have introduced mandatory standards, while others still rely on voluntary approaches and industry self-regulation. In many countries, the average fuel economy has gradually improved since standards were first introduced in the mid-1970s. However, significant further review of these regulations will be required if the projected increase in global carbon dioxide emissions is to be curbed. The United States has recently increased its corporate average fuel economy regulation standards, with a view to improving vehicle fuel economy in order to attain 35.5 miles per gallon in 2016 (equivalent to 6.6 litres/100 km).¹⁷

53. Several new initiatives and international partnerships have been formed to support multi-stakeholder collaboration on fuel economy, including the Low Carbon Vehicle Partnership based in the United Kingdom and the Global Fuel Economy Initiative of UNEP, IEA, the International Transport Forum and the FIA Foundation for the Automobile and Society.

54. Retail prices for motor fuels differ considerably from country to country, even up to a factor of eight, for various reasons, including different types and levels of taxation.¹⁸ Agricultural vehicles and machinery, as well as most trucks, buses and commercial vehicles, commonly use diesel fuel, which is often taxed and priced at lower levels than gasoline. However, fuel price subsidies have a disadvantage: they

¹⁵ FCCC/CP.1997/7/Add.1, decision 1/CP.3, annex.

¹⁶ See V. Ramanathan and G. Carmichael, "Global and regional climate changes due to black carbon", in *Nature Geoscience*, vol. 1.

¹⁷ United States Government, Department of Transportation: *Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Year 2011* (www.nhtsa.dot.gov/portal/fueleconomy.jsp).

¹⁸ German Agency for Technical Cooperation, *International Fuel Prices 2007*, 5th ed. Eschborn, Germany, GTZ, 2007.

cannot be clearly targeted, and other users and affluent constituencies can benefit equally along with the poor and less affluent. One of the challenges faced by fiscal policymakers is to design and implement fuel and motor vehicle taxes and subsidies in such a manner that negative external effects, including emissions and their impacts, could be internalized and reduced. Countries which continue to subsidize motor fuels may consider alternative options in order to support more directly eligible industries or the poor. Higher fuel taxes can discourage the wasteful use of energy, contribute to lower levels of emissions and generate revenues that can be used to finance public transport projects. A growing number of countries are promoting the use of liquefied petroleum gas and compressed natural gas, as well as synthetic fuels, in order to reduce local air pollution.

55. Whereas fuel efficiency is important for the operation of commercial vehicles, such as trucks and taxis, passenger cars are frequently seen as representing the owners' social status. Modern designs, greater engine power, increased seating capacity and additional features tend to attract consumers more interested in such aspects than fuel efficiency. As long as the majority of affluent consumers associate sizeable cars and high resource use with elevated social status, the marketing of small fuel-efficient vehicles will face formidable challenges.¹⁹ A number of countries have mandated that consumers be provided with information on describing the fuel economy labels of cars for sale in order to create a greater consumer preference for fuel economy.

56. Both ICAO and IMO project a significant resumption of growth in the global demand for air and maritime transport, which is expected to substantially exceed any future gains in fuel efficiency. Some estimates suggest that there are currently some 10,000 aircraft in the sky at any given time of day worldwide. Recent projections by ICAO suggest that the global fleet may actually increase from the 18,773 aircraft which were in service in 2006 to more than 44,000 aircraft by 2036. Emissions from aircraft have the potential for producing greater impacts on the process of climate change than other sources as they enter the atmosphere at high altitudes. The European Parliament recently adopted legislation which foresees the inclusion of intra-European air travel, as well as international air travel commencing in or arriving in countries of the European Union, in the pan-European emission reduction and trading scheme.²⁰ Inclusion of GHG emissions from international shipping and aviation in a future climate change agreement is urgently needed and is currently under discussion under the United Nations Framework Convention on Climate Change.

57. A very small but growing portion of emissions from transport is offset by travellers or tour operators through the purchase of carbon credits which provide (co)financing for environmental conservation and GHG reduction projects. Several airlines and tour operators offer carbon-neutral travel services. Extrabudgetary support provided by donor countries has also enabled the United Nations to organize a growing number of conferences in a carbon-neutral manner.

¹⁹ Wolfgang Sachs, *For Love of the Automobile: Looking Back into the History of our Desires* (translated from the German by Don Reneau), Berkeley, CA, University of California Press, 1992.

²⁰ Directive EC/2008/101 of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community.

58. Currently, no common set of internationally recognized indicators exists for measuring, reporting and verifying national and international action on mitigating the process of climate change as it relates to the transport sector. The harmonization of methodologies and greater international support for developing countries in their efforts to improve their databases constitute important prerequisites for the eventual inclusion of transport projects in future emission monitoring and trading systems.

G. Transport technologies: developments and prospects

59. Significant improvements in transport technologies and ground-breaking innovations are urgently needed to address the challenge of making transport sustainable.

60. Considerable potential exists for increasing fuel economy and reducing carbon dioxide emissions with existing motor vehicle technologies, by reducing vehicle size and weight, and rolling and air resistance, as well as accessory loads. The Global Fuel Economy Initiative partnership has estimated that vehicle fuel efficiency of approximately 4 litres per 100 km is achievable using existing technologies. Greater use of advanced direct-injection engines, as well as hybrid drive-trains and turbochargers could raise fuel efficiency. Several studies suggest that fuel-efficient tyres could also help to save up to 5 per cent or more of the fuel consumed by motor vehicles. A scheme of fuel efficiency labelling for car tyres has been proposed for consideration by the European Parliament.

61. High levels of emissions from older vehicles are largely due to poor maintenance. Mandatory periodical technical inspections could significantly contribute to reduced air and noise pollution, as well as road safety. Effective enforcement of existing regulations and the adoption of adequate air quality and emission control standards could offer low-cost options for enhancing the sustainability of transport.

62. Several countries launched economic stimulus programmes in 2009, with a focus on the car industry. Some of these programmes are aimed at accelerating the scrapping of older cars and increasing the rate of change in the vehicle fleet towards more fuel-efficient models. Some countries have also passed legislation, including obligations for car manufacturers to increase the rate of recycling of motor vehicle parts and materials. Many of these initiatives have made important contributions to the "greening" of economic growth, safeguarding existing jobs and creating new ones while simultaneously reducing the environmental footprint of the transport sector both now and in the future.

63. Many second-hand vehicles are exported from industrialized countries to developing countries. The restrictions that developing countries place on such imports are important in preventing high-emitting, unsafe or unsuitable older cars from being imported into such countries. Some developing countries have banned altogether the importation of used motor vehicles.

64. Poor-quality fuels can also contribute to poor performance and negative environmental impacts. Including lead additives in fuel was banned in most countries after such chemicals had been found to have serious implications for human health. The presence of lead in gasoline also greatly impedes the treatment of exhaust with catalytic converters. The Partnership for Clean Fuels and Vehicles of

UNEP has successfully assisted many developing countries to reduce vehicular air pollution through the promotion of lead-free, low-sulphur fuels and cleaner vehicle standards and technologies. The partnership has achieved an almost complete global phase-out of leaded gasoline.

65. Another pollutant commonly found in fuel is sulphur, which is contained in varying quantities in different crude petroleum stocks. Refining processes can remove sulphur from fuel, but doing so raises production costs. Heavy fuel oil used in maritime shipping often contains high levels of sulphur. In order to reduce air and maritime pollution in coastal areas, a growing number of countries are implementing regulations to progressively limit the sulphur content in fuel used for shipping.

66. Investment in biofuel production has increased significantly, particularly during recent periods when oil prices reached high levels. Biofuel production nearly tripled between 2000 and 2007; currently it accounts for about 2 per cent of global fuel consumption for transport.²¹ A growing number of countries support the production of biodiesel and ethanol through subsidies, reduced taxes and regulations requiring mandatory blending of biofuels with petrol or diesel fuel. Research at local and national levels is essential to assess comprehensively all ecological and other impacts in this regard. Second-generation and advanced biofuel technologies based on non-edible feedstocks, such as cultivated algae, could make a significant contribution to sustainable development. Also under study is the potential use of biofuels in aviation.

67. Mobile air-conditioning systems tend to increase the fuel consumption of cars and concomitantly their GHG emissions by 2.5-7.5 per cent.²² The leakage of environmentally harmful refrigerants still poses a considerable challenge, particularly in developing countries. Progress has been made in limiting such emissions through implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer.²² The rapid switch from the refrigerant dichlorodifluoromethane (CFC-12) to 1,1,1,2-Tetrafluoroethane (HFC-134a) has led to a decrease in carbon dioxide emissions from mobile air-conditioning systems from about 850 million tons of CO₂-sq to 609 million tons between 1990 and 2003, despite the continued growth of air-conditioned vehicle fleets globally. However, further research into and testing of other alternative refrigerants with a lower potential for contributing to global warming, including 1,1-difluoroethane (HFC-152a) and carbon dioxide (R744), are still needed. Training programmes, certification of service professionals, as well as adequate disposal practices, are also urgently needed in developing countries to further reduce the leakage of refrigerants.

68. Electric vehicle propulsion technologies are expected to play a greater role in the future than they do now. A growing number of vehicle manufacturers have announced plans or have started producing electric vehicles, primarily for use in urban areas. In several countries, including China, electric bicycles have become very popular. In Israel and in several other countries, including France and the United Kingdom, pilot projects have been launched with the aim of introducing

²¹ See Food and Agriculture Organization of the United Nations, *The State of Food and Agriculture 2008. Biofuels: Prospects, Risks and Opportunities*, Rome, FAO, 2008 (www.fao.org/docrep/011/10100e/10100e00.htm), and Third World Network (www.thirdworldnetwork.org.sg/).

²² United Nations, *Treaty Series*, vol. 1522, No. 26369.

electric vehicles in larger numbers, together with networks of service stations for rapid on-site battery exchange and battery charging. In Iceland, a pilot project has introduced a number of public fuel-cell buses powered by hydrogen obtained from water electrolysed by using renewable energy. In enabling a solar-powered prototype vehicle to drive around the world, the Switzerland-based "Solartaxi" project has shown that a combination of mobile and stationary photovoltaic panels and high-efficiency batteries can make carbon-free mobility possible at relatively affordable costs.²³ Technologies for using solar energy in maritime shipping and aviation, and wind energy in shipping are also being developed and tested.

69. When assessing GHG mitigation options it is important to consider life cycle impacts. This is especially true for making choices among available alternative fuels or technologies. Electricity and hydrogen can offer important opportunities to de-carbonize the transport energy system, but the realization of full-cycle carbon reduction depends upon the way in which the electricity and hydrogen are produced. Therefore, greater use of electricity or hydrogen for private motor vehicles would be sustainable only if such future systems are increasingly based on renewable sources of energy.

70. Significant increases in public and private funding will be needed to enhance the development, testing, demonstration, commercialization and dissemination of new sustainable low-carbon transport technologies, transport fuels and fuel storage systems, including durable high-capacity and high-efficiency batteries for electric vehicles. Attractive incentives could also play an important role in motivating the invention of sustainable transport technologies and advances. Larger-scale production of affordable electric vehicles will require a number of alternative materials, notably lithium, for which new industries and sustainable mining and processing technologies will need to be developed.

71. New information technologies, such as global positioning and intelligent transportation systems, including "smart highway" systems, provide various opportunities to facilitate traffic flows, reduce pollution levels and increase transport safety.

72. The majority of clean fuel and alternative vehicle technologies are available predominantly in industrialized countries. The development of alternative vehicle technology requires significant capital investment for research and design that is unavailable in most developing countries. Accelerated deployment of sustainable transport systems for all will not be possible without systematic and much greater technology sharing and technology transfer to developing countries than is currently taking place.

H. Intergovernmental cooperation

73. All regional commissions emphasize the importance of transport for sustainable development and facilitate the intraregional and interregional exchange of experience, as well as technical cooperation activities. The Inland Transport Committee of the Economic Commission for Europe (UNECE) has established a comprehensive framework of 57 international agreements and conventions related to cross-border infrastructure networks, uniform and simplified border-crossing

²³ For further information see www.solartaxi.com.

procedures and other norms related to efficiency, safety and environmental protection. The Intergovernmental Agreement on the Asian Highway Network²⁴ and the Intergovernmental Agreement on the Trans-Asian Railway Network,²⁵ facilitated by the Economic and Social Commission for Asia and the Pacific (ESCAP), came into force in July 2005 and June 2009, respectively. The Agreement on International Roads in the Arab Mashreq²⁶ and the Agreement on International Railways in the Arab Mashreq,²⁷ facilitated by the Economic and Social Commission for Western Asia (ESCWA), have been in force since 2003 and 2005, respectively.

74. As the secretariat for the Convention on International Civil Aviation,²⁸ ICAO coordinates and regulates international air travel. Since the 1970s, ICAO has pursued common international policies, standards and regulations for environmental protection, focusing on aircraft noise, local air quality and global climate impacts. The convention exempts aviation fuels from taxation. In 2007, the ICAO Assembly established the high-level Group on International Aviation and Climate Change with a view to formulating the ICAO Programme of Action on International Aviation and Climate Change.

75. IMO helped develop the International Convention for the Control and Management of Ships' Ballast Water and Sediments²⁹ which was adopted in 2004. It requires all ships to conduct ballast water management procedures to a given standard. As of July 2009, 18 States have ratified the convention, representing 15 per cent of the world's gross tonnage. The IMO International Convention on the Control of Harmful Anti-Fouling Systems on Ships³⁰ was adopted in 2001 and entered into force in September 2008. IMO Member States also reviewed the Protocol of 1997 (Annex VI — Regulations for the Prevention of Air Pollution from Ships) to the International Convention for the Prevention of Pollution from Ships, 1973,³¹ as modified by the Protocol of 1978 relating thereto. It calls for a progressive reduction in sulphur oxides, nitrogen oxides and particulate emissions from ships.

III. Continuing challenges

76. The systematic integration of economic, social and environmental considerations in all aspects of transport policymaking and land-use planning remains a key principal objective, as already envisaged in Agenda 21 and the Johannesburg Plan of Implementation.

77. The international community, in its efforts to promote a sustainable transport future for all, continues to face considerable barriers and multiple challenges, some of which appear to be even greater now than in the past. Policymakers for transport, development and the environment urgently need to find feasible common

²⁴ United Nations, *Treaty Series*, vol. 2323, No. 1-41607.

²⁵ See *Official Records of the Economic and Social Council, 2009, Supplement No. 19* (E/2009/39-E/ESCAP/65/32), para. 67.

²⁶ See E/ESCWA/TRANS/2002/1/Rev.2.

²⁷ See E/ESCWA/TRANS/2001/3).

²⁸ United Nations, *Treaty Series*, vol. 15, No. 102, p. 295.

²⁹ See International Maritime Organization, document BWM/CONF/36, annex.

³⁰ See International Maritime Organization, document AFS/CONF/26, annex.

³¹ See United Nations, *Treaty Series*, vol. 1340, No. 22484.

approaches and ways of expanding transport services for sustainable development, while enhancing without delay an effective, comprehensive and rapid transition to more sustainable environment-friendly low-carbon transport systems.

78. Leading researchers, including those working with the International Panel for Sustainable Resource Management established by UNEP, have also pointed out the need, as well as the many opportunities, to work towards a decoupling of wealth and natural resource use.⁸² For increasing resource productivity in transport, a comprehensive approach is required that seeks to (a) avoid or reduce transport demand, where possible; (b) encourage a shift towards less polluting and more efficient transport modes; and (c) improve and deploy clean transport technologies.

79. In developing countries, expansion of adequate transport infrastructure and environmentally benign and affordable transport services is urgently needed in urban and peri-urban and particularly in rural areas, in order to facilitate and enhance the attainment of the Millennium Development Goals, including reduction of poverty and improvement of physical access to public services, such as health care, education and markets. Safety, and social and gender concerns need to be better integrated into transport policies for development to be sustainable.

80. In industrialized countries, in the wake of the financial crisis of 2008-2009, many workers in the automotive industry and other transport services have lost their jobs and income. While continued and effective temporary government intervention and support remain urgently needed to cope with the social impacts, the crisis also offers policymakers many opportunities to provide incentives for a "greener" and more sustainable transport economy as a part of their economic recovery and stimulus packages.

81. Experience has shown that efforts to reduce the use of private motor vehicles in densely populated urban areas or commercial centres are more successful wherever they are affordable and, if needed, subsidized public transport alternatives are available. Urban bus rapid transit systems will have a particularly important role to play in providing sustainable transport options in developing countries and in their rapidly growing cities. Greater international financial support for investment in sustainable low-carbon public transport systems could significantly enhance the mitigation of the climate change process.

82. Travel activity related to tourism is projected to continue to increase worldwide, particularly in industrialized and newly industrializing countries. Preventing increased resource use, environmental impacts and unsustainable patterns of consumption in tourism remains a great challenge. Greater public awareness and promotion of eco-tourism could enhance more sustainable development of tourism.

83. National and international public-private partnerships, international financing institutions and the private sector could all make important contributions to the development and implementation of sustainable transport policies and projects.

⁸² Ernst von Weizsäcker, Karlson "Charlie" Hargroves, Michael H. Smith, Cheryl Desha, Peter Stasinopoulos, *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, London and Sterling, VA, United States, Earthscan, 2009.

84. Enhancing active public participation of all stakeholders and the identification of possible "win-win-win" approaches are essential prerequisites for mobilizing public support.

85. With effective regulatory frameworks and active public policy interventions, a more sustainable transport future for all is achievable. The Commission may wish to consider seizing the opportunity to map out a new vision and action plan on transport for sustainable development as an outcome of its policy debate in 2011.

Comparison of recent bus rapid transit system characteristics

	Bogotá	Sao Paulo, Brazil	Quito	Mexico City	Jakarta	Hong Kong, China	Manila	Shanghai
System	TransMilenio	Intertigado	Central Norte	Metrobus	Transjakarta	Hong Kong Metro	Metro	Real Vaya Phase Ia
Year	2000	2003	2004	2005	2004	2006	2006	2006
Total length (km)	84	104	12.8	20	37	27.2	41	28.5
Feeders length (km)	212			0		0		
Stations	104	327	16	34	63	16	32	20 (27)
Terminals	10	24	1	2	4	1	2	
Fare collection	Smart card	Smart card	Paper ticket	Smart card	Electronic	Smart card	Electronic transit pass	Smart card
Number of trunk vehicles	841 articulated 344 feeder	1 073 articulated 12 638 other	74	97	162	48	274	41 articulated 102 standard size
Passenger capacity	160	100	160	160		160	112 articulated 230 double articulated	75 standard
Passenger trips per day	1 450 000	2 760 000	120 000	260 000		40 000	600 000	69 000
Peak ridership	45 000	20 000	6 400	8 500	3 200	1 500	17 000	
Average speed	26 km/h	18 km/h	23 km/h	19 km/h	17 km/h	24 km/h	41 km/h	
Average maximum waiting time at peak	3 minutes	30 seconds	2 minutes	63 seconds		2 minutes	1 minute	4 minutes
Fare (in United States dollars)	0.51	1.05	0.25	0.35	0.39	0.40	1.50	

	Buenos Aires	Sao Paulo, Brazil ^a	Qatar	Mexico City	London	Montreal, Quebec	Seoul	San Francisco
Planning cost (in millions of United States dollars)	5.3	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total infrastructure cost (in millions of United States dollars per kilometre)	8.2	3.5	1.4	1.5	1.35	0.7	5.7	6.2

Source: Institute for Transportation and Development Policy (ITDP), Bus Rapid Transit Planning Guide, New York: Global Environment Facility, German Agency for Technical Cooperation, UNEP, Viva (York Region Rapid Transit Plan) and ITDP, 2007.

^a Dario Hidalgo and Pierre Graftiaux, "BRT systems in Latin America and Asia: results and difficulties in eleven cities", paper presented at the 87th Annual Meeting of the Transportation Research Board of EMBARQ, the World Resources Institute Centre for Sustainable Transport, Washington, D.C., 13-17 January 2008.

^b Dario Hidalgo, EMBARQ, The World Resources Institute Centre for Sustainable Transport.